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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE
AMERICAN MACHINIST PUBLISHING CO.,
256 BROADWAY, NEW YORK.

Some Leading Articles in this Number.

A Large Rope-Driving Fly-Wheel.
Putting Independent Exhaust Valves on a Corliss Engine.
Threading and Bending Bicycle Spokes.
A Pneumatic Crane in a Machine Shop.
Some Ancient Drawing Instruments.
Electrotechnics.
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A New Planimeter.

NINETEENTH YEAR.

No. 9,
Feb. 27,
1896.

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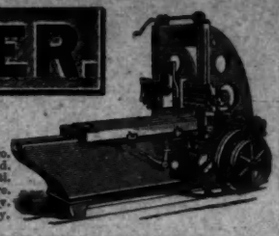

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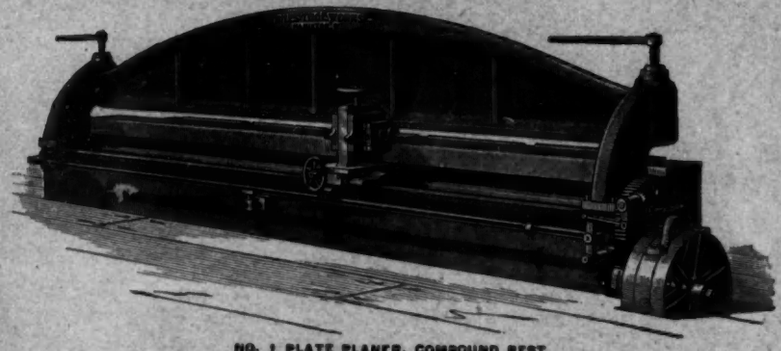

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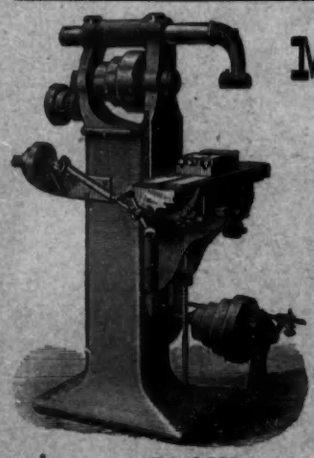

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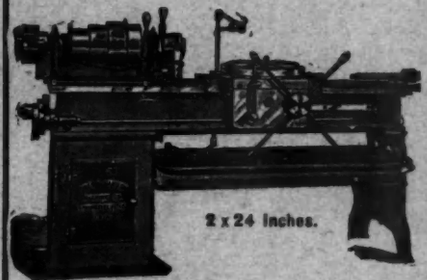

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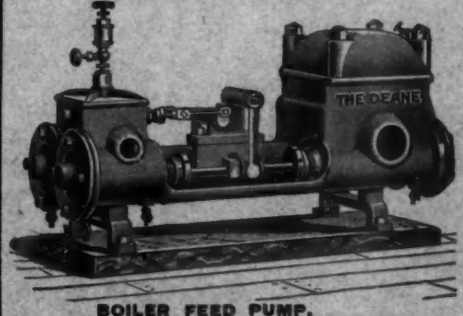

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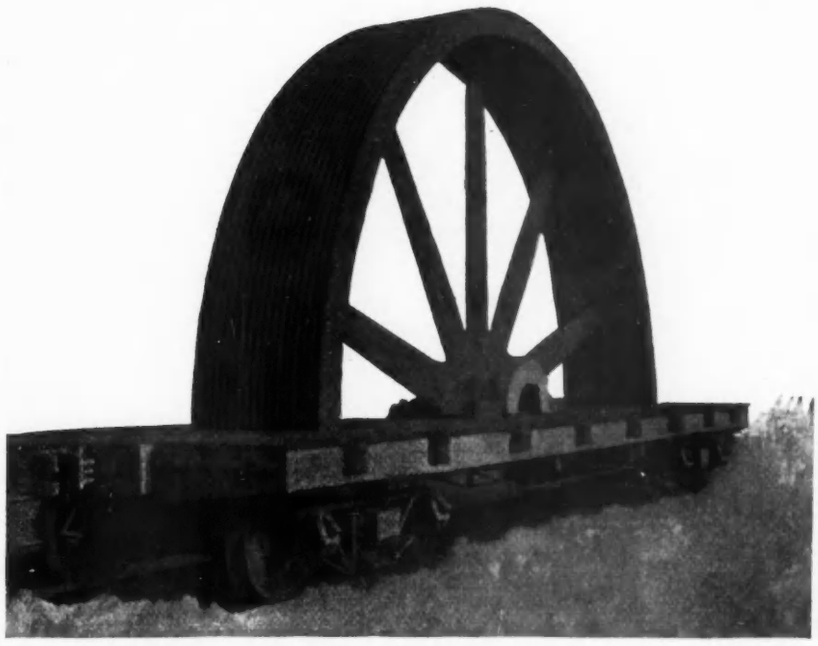
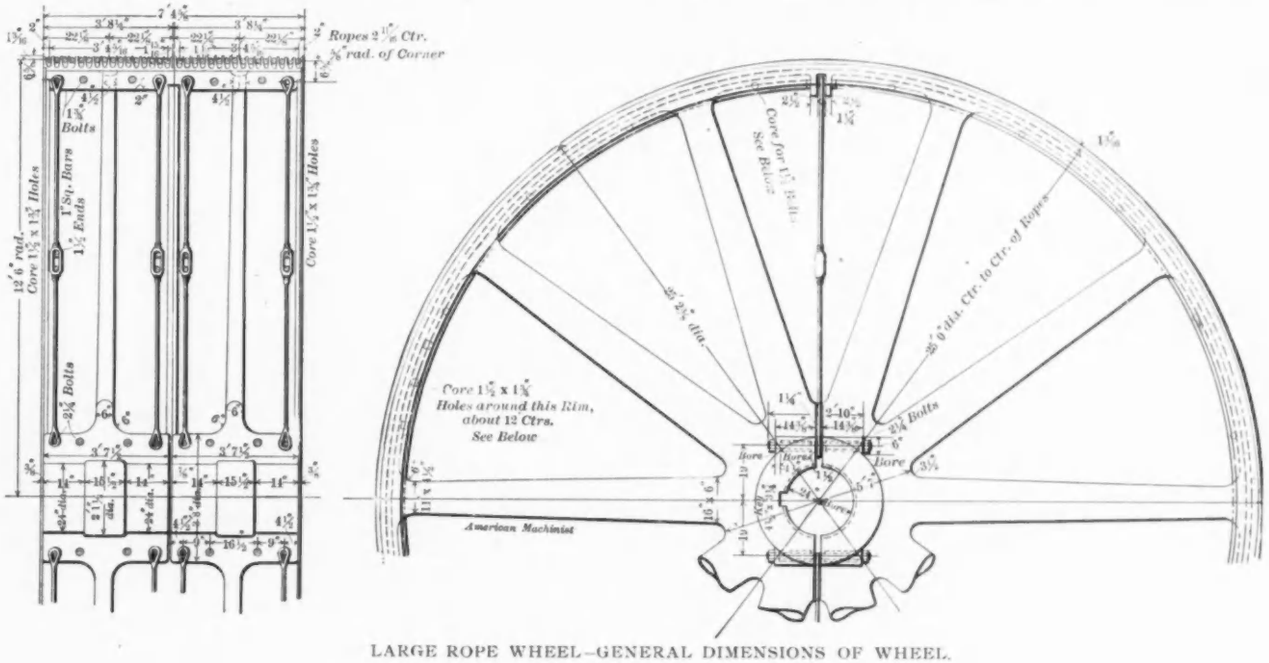
A Large Rope-Driving Fly-Wheel.

By the kindness of Mr. F. A. Rider, superintendent of the Bass Foundry & Machine Works, Fort Wayne, Ind., we are enabled to lay before our readers a half-tone showing one-quarter of a large rope-driving fly-wheel, loaded upon a special flat car for transportation, and also the working drawings, with full dimensions, from which the wheel was built. The Bass Company have recently built and shipped three wheels like the one here shown, or twelve castings in all, each casting weighing 50,000 pounds, to the New Castle Steel & Tin Plate Co., New Castle, Pa. They have also shipped recently a number of smaller wheels, ranging from 10 feet to 22 feet in diameter, all for rope driving.

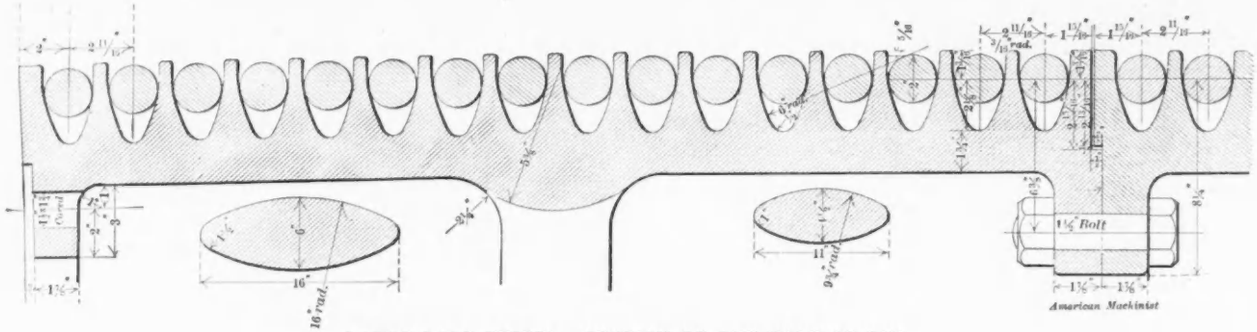
The wheel shown here, as will be seen from the dimensions given upon the drawings, was 25 feet in diameter, 7 feet 4⅝ inches face, 24 inches bore, and weighed complete 200,000 pounds, or 100 tons. The wheel carries thirty-two 2-inch ropes; we are not informed as to the actual power intended to be transmitted, or even



ONE QUARTER OF WHEEL IN TRANSIT.


Ropes 2 1/16" Ctr.
1/8" rad. of Corner
1 1/4" Bolts
1" Sq. Bars
1 1/2" Ends
Core 1 1/2" x 1 3/4" Holes
12'6" rad.
2 1/4" Bolts
Core for 1 1/4" Bolts See Below
35' 2 1/2" dia.
35'0" dia. Ctr. to Ctr. of Ropes
Core 1 1/4" x 1 3/4" Holes around this Rim, about 12 Ctrs. See Below
2 1/4" Bolts
Bore
American Machinist

LARGE ROPE WHEEL—GENERAL DIMENSIONS OF WHEEL.



LARGE ROPE WHEEL. SECTION OF ONE-HALF OF RIM.

the speed of rotation. It will be noticed that the half-tone and the drawings do not agree as to the location of the key seat. Of course, the half-tone tells the truth as to the final fact; but we believe that the drawing shows the theoretically preferable practice. We cannot dismiss this interesting wheel without expressing a wish that the limitations of our railroads would permit the transportation of still larger wheels, so that we might have the pleasure of exhibiting their photographs.

Placing Independent Exhaust Valves On a Corliss Engine.

BY CHARLES A. HAGUE.

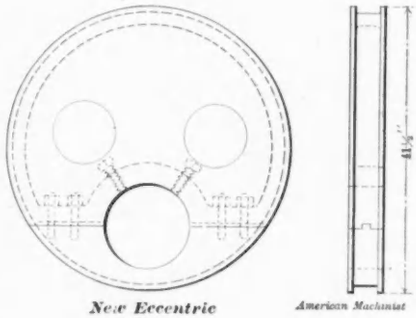
With the view of obtaining compression and exhaust lead, and at the same time lengthening the range of cut-off, it had been decided to attach to a large Corliss vertical engine an eccentric for the operation of the exhaust valves, independently of the steam valves, thereby dispensing with steam lead, getting the steam eccentric as far back as possible, and securing the best exhaust lead and compression; entirely impossible with a single eccentric, without very greatly restricting the range of cut-off.

The engine was 28 x 60 inches, non-condensing, making 50 revolutions per minute, with an initial steam pressure of 80 pounds. The fly-wheel, which was also the belt wheel, was rather light and small for the engine, and the distance between centers of crank shaft and jack shaft was unusually short.

After the engine had been put into service, several things of an undesirable nature developed; and the relation of how the writer met and disposed of them may be of interest, especially now, when the question of adapting steam engines of large power to electrical and electrically-operated machinery, is becoming more and more pressing.

It was found that the engine would not pass the centers quietly, especially the bottom center, without considerable compression; and to get the compression, either the exhaust lead had to be sacrificed, or, by setting the eccentric ahead to obtain exhaust lead and compression, to sacrifice the range of cut-off. Before any reasonable adjustment of the exhaust valves could be secured, the range of cut-off would shorten down to a point which just about met the maximum load; and consequently the engine would very often take a full stroke of steam, making an unsteady motion with the light wheel, and, during a day's run, seriously affecting the economy. The problem, then, was how to let out on the range of cut-off, and at the same time secure compression and exhaust lead. The answer was, put on another eccentric.

The main belt, which was of double leather and 40 inches wide, could scarcely keep from slipping at the full load, even with steady motion, on account of the closeness of the shaft centers depriving it



New Eccentric
Fig. 1

of a proper wrap upon the driver pulley, and also of the benefit of its weight. Therefore, when the engine would plunge and race, very serious slipping often followed.

There were three difficulties, then, to be overcome, viz., to obtain compression without interfering with any other function, to steady the motion of the engine, and to stop the slipping of the belt. It was at first thought that the first item, very important on its own account, would go far towards curing the other two ills; but the sequel showed that each trouble had to be treated for itself.

The crank and the fly-wheel hub had been forced upon the shaft and keyed in place. The single eccentric had been slipped upon the shaft between them and held in place by two set screws, before the wheel hub had been put in place. The second eccentric, therefore, was made in two pieces and bolted together. These eccentrics were each 40 inches in diameter, there being no multiplication of the motion by a carrier arm, as is usual; the width of the face for the strap bearing was 4 inches. Fig. 1 shows the eccentric, the joint with its bolts being the only perceptible distinction. The new eccentric rod was made in two lengths, because there was no lathe long enough; the joining of the two pieces was incidentally made use of in providing a means of adjustment for the length of the rod. Fig. 2 shows this rod.

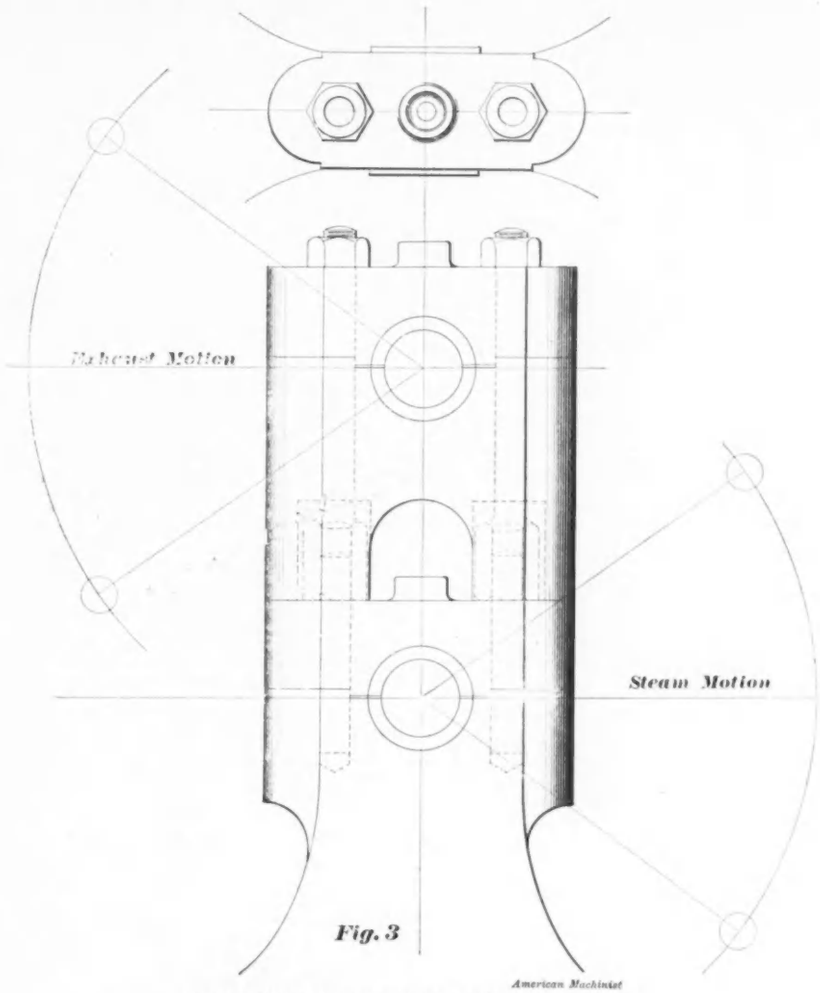
The original rock shaft was about halfway between the eccentric and the wrist plate, vertically above the main shaft. This rock shaft had its bearings in a pair of pillow blocks; the cap nuts of these pillow blocks were removed, the caps being held in place by socket bolts, as shown, and the pedestals for the upper rock shaft were secured on top of the lower rock-shaft caps. See Fig. 3.

The driving rod from the original rock shaft to the wrist plate was an ordinary connecting rod, with butt and strap joints, unhooking of the engine being arranged for at the upper end of the main eccentric rod; although in regular practice the engine was never unhooked, the throttle valve only being shut. The new rock shaft was connected to the new half wrist plate by a rod made like the original one. The substitution for the original single wrist plate, of two half wrist plates, working upon the original stud, caused considerable scheming, but was finally accomplished, as shown in Fig. 4.

Fig. 2

NEW ECCENTRIC ROD.

The engine was shut down one night at six o'clock, as usual; the original work not needed in the change was removed, the new work attached, and the engine started up under the new conditions about

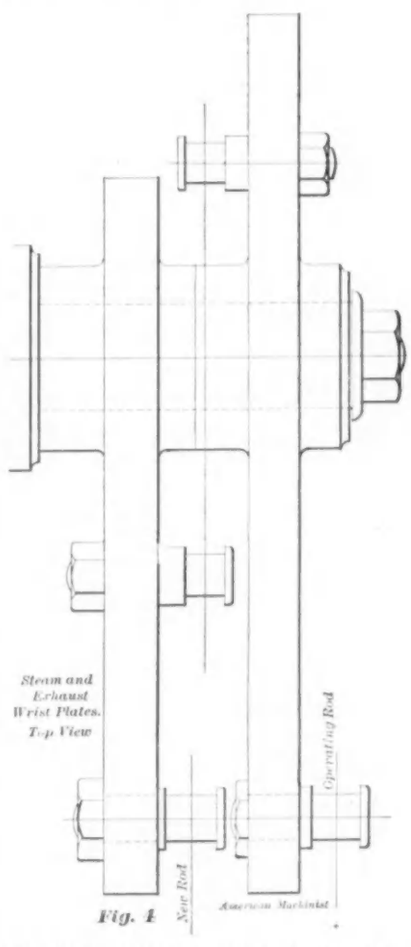


IMPROVISED] BEARING FOR SECOND ROCKER.

midnight. The back valve bonnets had been removed and the valves set nearly enough for operation, by the usual marks. The engine was started up in the morning on time, without any hitch whatever, and then the different adjustments of valves were made, with the help of indicators, during several subsequent weeks. Considerable interesting experimenting as to the extent and possibilities of compression was incidentally accomplished under the conditions there present, of steam quality, speed of piston, volume of clearance, ratios of expansion, etc. About 45 pounds compression in the lower end of the cylinder, and 25 pounds in the upper end, was decided to be the best. The original eccentric was used for driving the induction valves, and the new one for the exhaust valves. The induction valves were set with the lead at the top end, a trifle negative, and at the bottom end, line and line; the result being an absolutely noiseless operation of the main reciprocating parts, and a take-up on the crank-pin boxes represented by one-eighth of an inch drive of the key in a year. The rule with the crank-pin key was never to back it after the first set; the practice followed was to draw a lead-pencil mark alongside of a rule, crossing the joint between the gib and the key, then driven up the key until the pencil mark was perceptibly broken by the travel of the key; this practice, followed at long intervals, left nothing to be desired. The exhaust lead was made very liberal, so as to release the steam while it had 2 or 3 pounds pressure at short cut-off, thereby starting the column in the unusually long exhaust pipe promptly, and so keeping the counter pressure well down and out of the way of the returning piston. The average difference in the counter pressure was 2 pounds to the good, making a net gain of 18 horsepower over the best possible results before the change was made. Figs. 5, 6, 7 and 8 show the indicator evidence before and after the change.

The range of cut-off was increased by the setting-back of the steam eccentric, so that the skipping of the cut-off was entirely prevented up to about six-tenths of the stroke, nicely covering all variations. The indicator very clearly determined how far compression could be carried consistently with the mean temperature of an unjacketed cylinder working steam expansively; the work of compression failing to carry the curve anywhere near the initial pressure with a cylinder and piston cooled down by steam expansion, and exposed to the lower temperature of the exhaust steam. A better illustration of the practical use of a steam jacket could scarcely be found; and the writer regrets that he was not enabled, by the presence of a steam jacket, to demonstrate, in that particular case at least, how much effect upon compression would have been produced by the reinforcement of latent heat. The relation between the production of the compression curve and the temperature of the iron was plainly shown by the indicator diagram. When the exhaust valves were adjusted, which could be done by means of the right and left screws of the radius rods, while the engine was running, for various degrees of compression, it was found that when the curve reached about 55 pounds there was a decided hook between the upper end of the compression and the beginning of the induction admission line. By pulling in gradually upon the radius rods, this hook would decrease as the curve fell, until, at 48, a mere dot showed that the pencil paused an instant in its upward movement; and at 45 the curve slid beautifully into the straight upward admission line without a blemish.

The writer's theory is that the compression curve, rapidly formed, and, driven



SECOND WRIST PLATE ON ORIGINAL PIN.

upward considerably faster than hyperbolic proportions warranted, suddenly found itself in a temperature due to a steam pressure of about 45 pounds; and, of course, as there was no source of heat beyond the equivalent of the work absorbed in compression, condensation began immediately after the thermal equilibrium was passed; but the engine reaching the center, the inrushing steam, with three boilers to draw from, instantly supplied all losses, and forced the initial pressure up to the highest point consistent with the payment for the transportation between the boilers and engine. Hence, when the compression just reached a point where the temperature of iron would support it, all went smoothly; but if this point was exceeded, the curve reversed until it met the induction.

The valves after a short time having been adjusted to the best practicable point, by the use of indicators, it was one day discovered that the engine would occasionally plunge and race as before, although not so severely; and investigation showed that the main belt was so nearly loaded to its driving capacity under the circumstances, that different atmospheric conditions would cause good or bad performance. Further investigation revealed that a slight pressure of the thumb and fore-finger, protected by a little bunch of cotton waste, upon the governor rod leading to the "dash pot," would completely control the engine, which, of course, amounted to increasing the resistance in the dash pot. But different fluids, of various degrees of viscosity, in the dash pot did not control nearly as well as the slight pressure of the thumb and finger upon the rod; therefore, a small cast-iron clamp was made, lined with leather, and secured to the upper steam chest near where the governor rod passed downward to the dash pot. See Fig. 9.

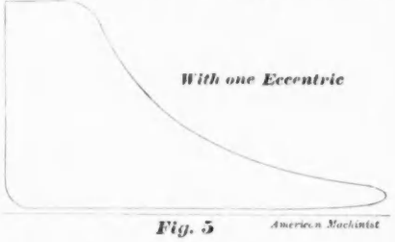


Fig. 5 American Machinist

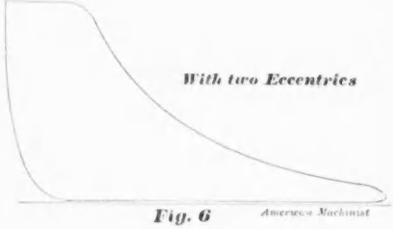


Fig. 6 American Machinist

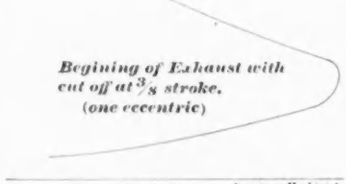


Fig. 7 American Machinist

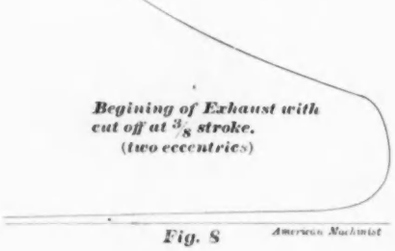


Fig. 8 American Machinist

This clamp being oiled occasionally, and having been properly adjusted, made the most beautiful controller that could be imagined; and right here it will be apropos to mention that a good heavy fly-wheel is more important in regulating the speed of a steam engine than any other thing. A certain well-known engineer, high on the roll, in filling a "hurry order," put a wheel meant for a 20-inch engine upon a 16-inch engine rather than wait for a regular wheel to be cast; and the result was that that 16-inch engine regulated most perfectly without any dash pot, or any other steadying device for the governor; the moral of which is, that competition may be the life of business, as some folks say, but it also prevents the engineer doing his best. Just imagine the value of a few hundred pounds of foundry casting standing in the way of a permanent and valueable benefit to the buyer, and by his own action at that!

The third trouble was finally exposed after the removal of the preceding ones, and that was the fact that the main belt was being worked under conditions entirely at variance with successful operation. The main shaft and the jack shaft were so close together that there were no chances for the effects of the weight of the belt to be realized, although, under ordinary conditions, a belt of the width given would have been ample for the power. Therefore, it developed that that concession to poor opportunities for good engineering, known as a belt-tightener, had to be resorted to, to steady the belt, hold in the slack, and give a wrap of at least 180 degrees upon the jack-shaft pulley. Even the space available for the tightener was restricted; and the device to serve the purpose, resulting from the environment, developed into a construction as shown in Fig. 10.

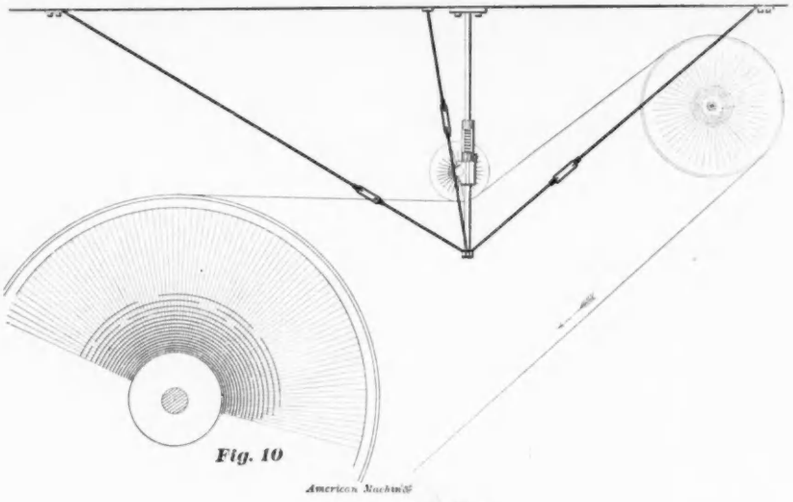
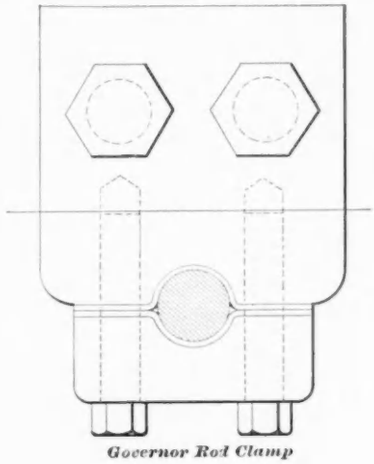


Fig. 10 American Machinist

BELT TIGHTENER.

Two pieces of 3 inch cold-rolled shafting, each 12 feet long, had a screw cut upon each of their ends; one end of each then being screwed into a heavy wrought-iron foot plate, 6 inches wide, 2 inches thick, and 16 inches long. These plates were then bolted securely to the ceiling



Governor Rod Clamp

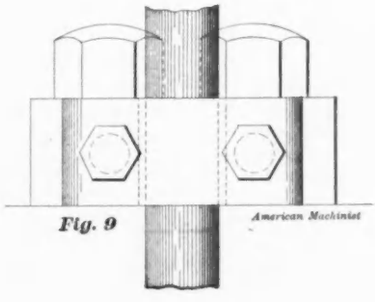


Fig. 9 American Machinist

above the belt, by bolts through iron plates let into the floor above. To the lower ends of these shafts, now converted into a pair of very strong stanchions, were secured stirrups arranged to accommodate turnbuckles and rods leading in various directions. The letting-out and tightening-up of the different turnbuckles, operated to "steer" the belt exactly as desired; the shafts were in good line and level; but the guiding pressures made possible by the guy rods were useful in correcting any distorting of the belt when under strain.

The "idler" pulley running upon the back was composed of two pulleys, each 36 inches diameter, and with a combined face of 48 inches, so that there would be some leeway for any lateral movement of the belt. These pulleys were fastened to their shaft, 4 inches diameter, and the journals at the ends of the shaft revolved in specially designed boxes, somewhat resembling post hangers, but arranged so that they had a vertical swiveling motion, and were automatically adjustable to the sinuous tendencies of the belt. These swivel boxes were in turn secured to cast-iron sleeves having an easy fit upon the 3 inch shafts, and above these sleeves were heavy, strong steel springs, held down by collars, these collars being fastened by set screws. When it was desired to tighten the belt, a piece of joist was thrown across it, just back of the idler, and to the ends of this joist were attached a sling-and-rope tackle; then an easy, downward heave tightened the belt, and the idler, of course, followed it down; the collars above the springs were let down to correspond, secured in their new position, the tackle and joist removed, and the thing was done. A tightener upon the back of a belt is a rather brutal affair, but in this case was an absolute necessity; and, as a matter of fact, acted, with the moderate amount of force applied, almost entirely as a steadier rather than a tightener; the pull of the tackle representing, approximately, the strain upon the belt when driving the load.

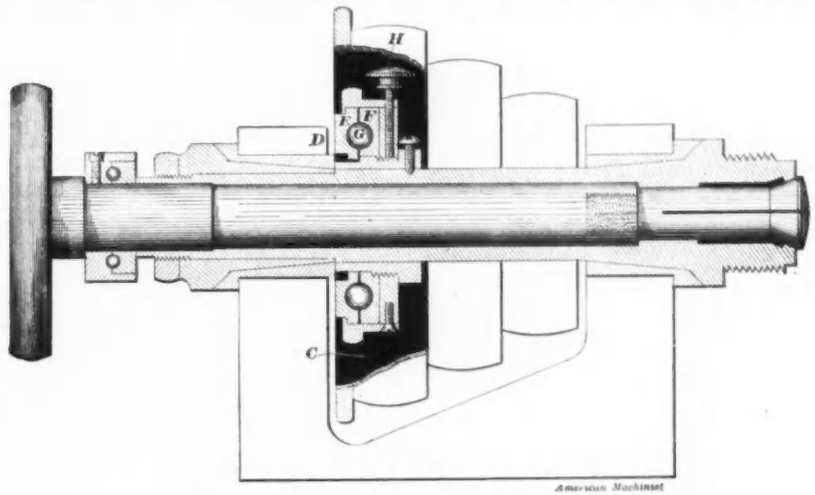
Ball Thrust Bearings on Bench Lathes.

We give herewith an illustration showing the application of ball thrust bearings to the head of a bench lathe such as is used in watch factories and for similar work. The larger collar inside the cone pulley is more especially for relieving the the main bearing when drilling; which operation, on account of the end pressure brought upon the bearing, tends to heat it.

With this bearing, when drilling is to be done, the collar *C* is turned back upon the spindle until *E* is brought into contact with the head, and the screw *H* is then tightened to prevent displacement. The ring *E* then remains stationary, and the end thrust of spindle is carried upon the balls *G*.

A ball bearing is also used for the draw spindle, the arrangement of which will be readily understood from the engraving, as it consists simply of two disks, one of which turns with the wheel, and between the disks are placed the balls. This bearing permits the work to be very securely held by the exertion of the minimum force upon the wheel.

This improvement is being used upon such lathes built by John Stark, Waltham, Mass.



BALL BEARING FOR BENCH LATHE.

Taper Bushes for Drilling Jigs.

The jig which is intended for the production of parts which are required in large numbers, will always have its holes fitted with hardened bushes driven in place. Such bushes, however, add considerably to the cost of the jigs; and where the product is wanted in limited quantity only, it is often a question if the cost of such bushes is justifiable. Consequently, many jigs intended for such work have the bushes omitted—the toolmaker consoling himself with the reflection that the evil day when the holes will be badly worn is a long way off. In some shops jigs of this kind have removable bushes, the outside of the bushes being straight and made a snug, crowding fit into the jig holes. Such bushes are changed from hole to hole in the jig, and from one jig to another—a few bushes thus supplying a large number of jigs. The holes in the jigs are made with a standard reamer, to render this interchange of the bushes practicable. This plan is far preferable to the use of plain holes without bushes, but is not entirely satisfactory. It is, of course, not easy to maintain sufficient uniformity with reamers to insure the fit desired between the bush and the jig hole; and even if made, the fit is not permanent. With repeated insertions and removals of the bush, the fit will finally become free; and once this stage is reached, chips will crowd in between the drill and the bush hole, binding drill and bush together, and thus causing the bush to turn in the jig hole. When this stage is reached, further wear is rapid, of course.

An expedient which is not so widely known as it deserves to be, is to make the jig hole and the outside of the bushes taper. The bush can then be crowded to its place with the thumb, or a slight blow with the soft hammer. The wear between bush and jig hole is then very slow, and does not lead to the bush becoming loose in the hole, as it is taken up by the taper.

The jig holes should be made with a reamer kept carefully to a standard taper—resharpening the reamer not changing the size of the holes, as the reamer simply goes further into the hole after each sharpening. The reamer should be fitted with an adjustable stop, to gage the depth to which it goes into the holes—this stop being adjusted after each grinding. The same reamer will, of course, answer for a considerable range of bush sizes, as the outside of the bush can be made the same for several sizes of holes. The bushes should have thin hexagon heads, to permit their easy removal with a twist of a wrench. Each bush should be stamped with the size of its drill, and each jig hole should be correspondingly stamped to show the bush belonging to it. If this precaution is neglected, the raw apprentice boy on the drill press will inevitably spoil a lot of work.

It will be seen that with a set of bushes once provided, the cost of jigs made in this way is but little more than if not made with bushes, while the satisfaction obtained is far greater.

To insure that the bushes will stay in their places, but without sticking, the taper should be about two degrees each side of the center line.

Mr. Stanley E. Russell, who was the representative of the Q. & C. Co., at Atlanta, Ga., died on the 13th inst., of pneumonia.

An Improved Turret.

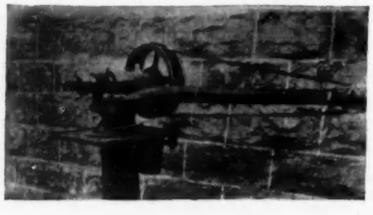
In a previous issue we have referred to a new form of turret being introduced by the Davis & Egan Machine Tool Co., of Cincinnati, O., and are now able to give further particulars regarding it.

A photograph of samples of work done by this turret without the use of box tools, indicates that its range of work includes all the work usually attempted on turret machines, and we regard the addition of this circular slot as an important improvement on turrets.

TURRET TAKEN APART.

We show the turret with its upper and lower portions separated, and also mounted for use upon the carriage of a 36-inch lathe. Its principal difference from the usual form of turret is in an extension at the base, which is provided with a T-slot in which can be placed tool posts of the ordinary form; so that, in addition to the usual tools held in the turret holes, ordinary forged lathe tools can be adjusted in this slot, and as many of them can be used as may be needed. A cut-off rest can also be used on the turret by attachment to this slot, and such a rest is shown at the left of the dismembered turret.

There is a separate stop screw for each tool, and each stop screw can be adjusted



STRAPPING ATTACHMENT.

separately for its particular tool, thus doing away with the necessity for adjusting each tool to precise position. For facing cuts also a turret and an ordinary post-held tool can be used simultaneously—one for roughing and the other for finishing.

In the case of the particular turret shown, 3-inch stock can be passed through the stem. Ten different sizes are made, and they are used either on lathe carriages or on regular turret slides, and revolve automatically or otherwise.

Strapping Attachment.

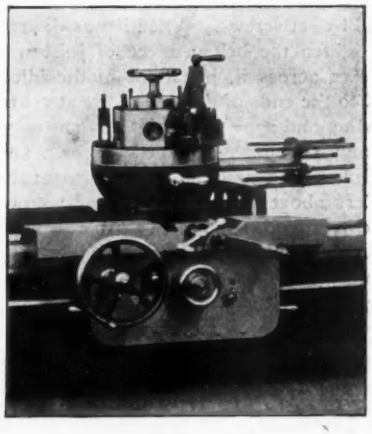
We give an illustration of a strapping attachment for a grinder, designed especially for bicycle frames, which can be placed over the projecting arm and strap when working on inside surfaces.

The arm is bolted on in place of the usual rests; an adjustment of the outer wheel is provided for, keeping the proper tension on the strap, and it is driven by a pulley put on the spindle in place of the emery wheel.

The upper portion of a grinder made by the same manufacturer, Perry Ransom, Oshkosh, Wis., is shown with the attachment upon it.

Canadian Exposition of 1896.

Our neighbors of the Dominion of Canada announce their first great exposition, which is to be entitled "The British Empire Exposition and International Display of All Nations," and to be held at Montreal from May 24th to October 12th of the present year. The exposition has been planned upon a liberal scale, and is intended to spread a knowledge of the products, resources and industries of all nations. All interests are to be provided for, the classification adopted embracing architecture and forestry, means of transport, general industry, food industries, river and sea fisheries, health appliances, machinery, lighting, industrial arts, heating, geographical information, furniture, means of safety, gardening, insurance, miscellaneous. A fine historical display is provided for, and an extensive department of fine arts. A special section of the exposition also is to be devoted to the Empire of India, a commissioner for that department being now in India for the purpose of arranging a characteristic and representative display, reproducing all the leading features of the varied and picturesque phases of native life and customs.

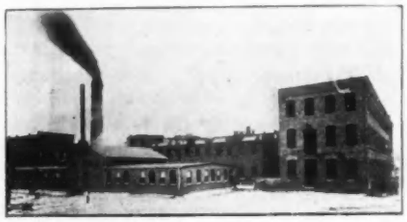


IMPROVED TURRET.

Although not mentioned upon the programs, the bird's-eye view of the grounds makes provision for the streets of all nations, not forgetting Cairo.

The accessibility of Montreal, and its attractions to summer visitors, independently of the wonders of the exposition, would seem to guarantee a large attendance, and enterprising American firms may be expected to take advantage of the opportunity offered. Space is to be charged for at the rate of $1 per square foot. The exposition buildings and grounds will be bonded warehouses for the exhibit of articles from foreign countries, without the payment of duty. The exposition is receiving solid support from the highest and most influential quarters, and it may be expected to prove highly successful and satisfactory. The Canadian people feel that they have spent a great many thousands of pounds in aiding

and exhibiting in expositions in all parts of the world, and that they now have the right to ask the aid and co-operation of all people to make their exposition a success.



THE LOZIER SHOPS AT TOLEDO, OHIO.

Bicycle Tools—XVIII.

Nothing else is so surprising to me, in connection with my study of the cycle factories, as the fact that excellent establishments reach diametrically opposite conclusions as to the best means of doing the same work. This is often the case, and shows very conclusively the need of a full understanding and comparison of cycle-factory methods. The Gormully & Jeffery factory is extremely good; excellence of product is the chief consideration in deciding what methods are to be employed; the deciding factor in all cases is the quality of work produced.

The same is true of the Lozier factory, of Toledo, O., which produces the "Cleveland" cycle, and nothing else. In this particular the Lozier is almost alone; nearly all of the cycle shops turn out two grades of work. The first grade is made at the parent shops and under the recognized trade name, which stands for first-class workmanship; the second grade is often made in another shop, by a nominally entirely separate concern, having a separate organization and a trade mark in no way suggestive of its well-known principal factory, which, however, controls the offshoot in every particular, and handles its product, in certain lines, exclusively. The Lozier makes but one quality of cycle, and that is intended to be superlative, I never before saw in any workshop such constant scrutiny of both methods and work produced as that given to matters in the Lozier shops. The result is, of course, high-class work, and also, of course, very high-cost production. The gage limit is small all through the departments of the Lozier, and only those thoroughly familiar with the production of interchangeable work know the enormous cost increase which is entailed by a seemingly slight and unimportant decrease of the limit of variation. The Lozier first made a $75 wheel, and made plenty of money. It now makes only the highest grade of wheel, retailing last season at $125, and at $100 this season; and, as Mr. Moore, the manager, expressed it, "the Lozier hopes it is making a reputation; it isn't making anything else of value, certainly not money."

As detailed in a previous paper, the Gormully & Jeffery, Columbia and Monarch, in common with many others, thread cycle spokes with cutting dies, because they have been unable to obtain a satisfactory approximation to uniform thread diameter with rolling dies. Under precisely the same conditions, the Lozier has failed to produce satisfactory work with cutting dies for threading spokes, and has returned to the use of the Blake & Johnson wire thread-rolling machine, with a preliminary sizing operation on that part of the spoke to be threaded, which is performed on the spoke ends singly, and with a single-blade cutting die, on Garvin spoke-threading machines.

This gives a curious analogy. Finding themselves unable to produce uniform diameter threads with cutting thread dies, the Lozier mechanics go back to rolling spoke threads, depending wholly on a hollow mill with a cutting edge to bring the spoke end dead to size before threading on the Blake & Johnson thread-rolling machine. I should myself say that of the two tools a threading die was more likely to stay up, and less likely to make work of varying sizes than a hollow mill; and I think I express the general opinion in regard to the work of the hollow mill and the closing threading die in saying this. The Lozier experience is, however, in direct contradiction to this commonly received opinion, that of all the hollow cutting tools the threading die is most easily kept up.

The assistant superintendent of the Lozier, Mr. W. L. Gleason, a very intelligent and vigilant young man, who has had a widely extended experience with hollow mills and threading dies, and whose opinion is worthy of the highest respect, told me that the cutting threading dies were given a thorough trial. The stock is extremely hard, in order to give a high spoke elasticity; with the cutting dies the spoke-threading job was a perpetual blister. In spite of the best efforts of the tool makers, there was constant trouble in wheel assembling. As a last resort, an order was given to a large firm, whose principal output is taps and dies, for the best dies they could produce; but these dies from abroad did no better than those made at home.

In this dilemma, resort was had to the expedient of bringing the wire to exactly uniform diameter with a hollow mill before putting the spoke through the Blake & Johnson thread roller. As this left the row of Garvin tapping machines, previously employed in threading spokes without work, the hollow mills were put on these tapping-machine spindles and the backing belts were taken off. The working parts of this spoke-sizing rig are quite plainly shown in Fig. 117. The fixture consists of a plain, eccentric-operated spoke-wire clamping jaw, mounted on a horizontal slide on the shears of the machine. The workman stands at the end of the machine facing the spindle, and gives the feed for the spoke-sizing cut by pushing with both hands, one on each side of the vise or clamping-carrying slide; the eccentric

Fig. 117.

SIZING SPOKES BEFORE THREADING.

lever is operated with the right hand, and the swing latch, *L*, Fig. 117, end gage, for locating the spoke, is operated by the first two fingers of the left hand. The hollow mill consists of two bearing jaws and one adjustable cutting jaw, located 120 degrees apart, in a plain, solid cast-

iron head. This cutting jaw or tool is screw adjusted inward, and can be very quickly moved. The work is very frequently gaged by the boy operator, who is a piece-work man, and knows his pay depends on his work passing rigid inspection. A supply of interchangeable cutting jaws or tools for these hollow mills is provided, and the operator changes his tool as often as it shows the least sign of dullness. The lubrication is flooded lard oil. The Lozier shops do not use a flood of lard oil in all cases for small cuts. On the chain job, water is quite generally used. With the rig shown, each hand can size about 4,000 spokes per day.

Fig. 118. BLAKE & JOHNSON SPOKE THREAD ROLLING MACHINE.

Wages for work of this sort are very high in Toledo, and, in fact, all machine-shop labor is unusually well paid in that town. Mr. Heartley, maker of cycle-shop tools, whose product was illustrated in the previous paper, said that the great demand for machinists caused by the development of the cycle industry in Toledo had raised machinist's wages from $2.50 to $3.25 or $3.50 per day, and that help had to be "handled with silk gloves," even when paid top prices, as they had only to choose where they would work. One of the largest New England makers of small machine tools recently said that his concern would not be paying taxes if it were not for the cycle factory orders. It will thus be seen that the cycle has carried the machine trade over a period which would, apparently, have been extremely dull for all the metal-working trades, had not the cycle sales redeemed the paucity of work in other lines.

The Blake & Johnson thread-rolling machine is fairly shown at work in Fig. 118. The cam on the front side of the crank disk operates the ejector. This is the original form of the Rudolphe & Krummel machine, Fig. 99. In this original machine the friction of the sliding die is taken by a bank of traveling rollers, printing-press platen style; such rollers must, of course, be very hard, must run on a hard track, and both rolls and track must be kept in perfect form by grinding. The threading dies are of the usual and well-known form, and the machine is one of the many which have come into being from the prolific old Blake & Johnson Waterbury establishment, which was one of the first of the small-tool makers of the Naugatuck Valley, and has been a nursery for automatic tool designers from the day that Johnson started it, some forty years ago, I think; perhaps not quite so long, but in the old days, when Yankee clocks were yet novelties and automatic tools were wonderful things, and a Yankee tool maker was an encyclopedia of small metal-work practice not to be found elsewhere in the world. The seed of all our American small-tool successes was sown along the waters of the Naugatuck, and the harvest has spread all over the civilized world, first from the east to the west of the United States, and then to Europe; so that now there is fast approaching a wonderful uniformity in small metal-working tools the world over. Blake & Johnson have rivals and imitators in many lands; although nowhere else than in Waterbury, perhaps, can there be found so many designers sufficiently familiar with the automatic handling and working of small pieces of metal as to be able to design, as mere routine everyday matters, the wonderfully ingenious and satisfactory tools there constructed for the automatic production of any small article from wire or sheet metal.

A large number of the Blake & Johnson wire threaders are in use, and the capacity of the machine is very great. Almost all of the Blake & Johnson machinery is of that class that must be fitted with the utmost precision to effect its purpose, and they are therefore accustomed to producing close-fitting and easy-running machines.

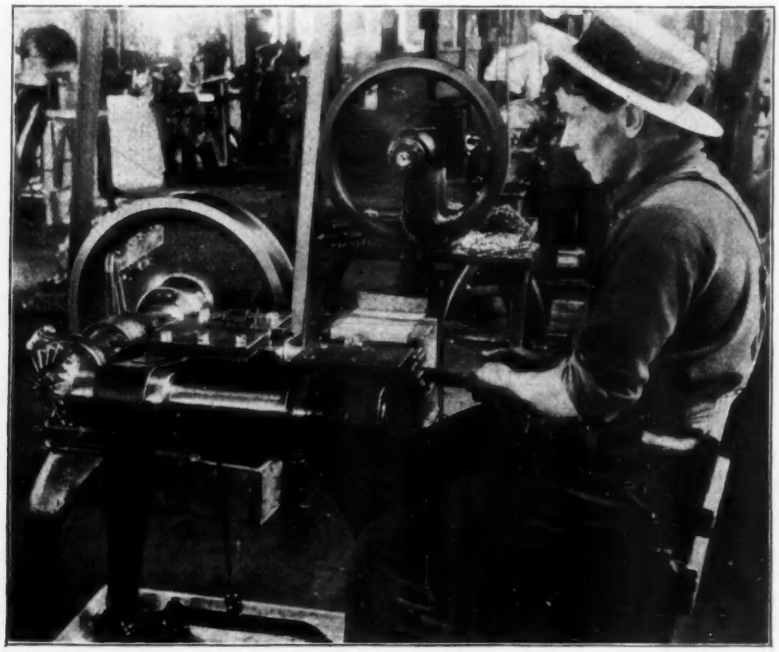


Fig. 119. BLAKE & JOHNSON SPOKE HEADER.

The Lozier spokes are headed on the Blake & Johnson header, shown in Fig. 119. This is simply a plain header, with

a cam-operated vise jaw. The engraving shows the operator at work, as well as the construction of the machine; the gear covers being removed to show the part arrangements clearly.

Unlike the Rudolphe & Krummel spoke header and bender, previously shown and described, the Blake & Johnson header does not bend the spoke. In the Lozier shops the spoke-bending is done on an extremely efficient hand trap, shown very clearly in Fig. 120, by the use of which one hand can bend the surprising number of 20,000 spokes per day with very great uniformity. This speedy machine consists of a pair of tongs pivoted to swing on the jaw joint; the jaws are cut out to exactly fit the spoke head and so much of the spoke body as is to stand square with the head after bending. In front of the nose of the tongs is seen the adjustable bending roll; the sweep of the nose of the tongs past this roll makes the bend, and the angle produced is defined by the position of the stop or "temper" screw in the post *S*, Fig. 120, at the right. In the engraving the reins of the tongs are grasped by the right hand of the operator. The reins are constantly urged asunder by a bow spring between them; if the operator pulls the far rein as far towards him as the stop pin *P*, Fig. 120, will permit, he gives the near rein of the tongs a fixed position, as it lies against the stop pin *P*, which is fast in a quadrant extension of the sole plate of the trap, and also opens the tongs jaws against the tendency of the spring. At the start the operator holds eight or ten spoke wires jaw-wise between the thumb and bent forefinger of his left hand, which rests on the front extension of the sole plate; when the jaws are open he guides a spoke head in place between them, and then a push on the near rein moves the spoke past the roll, the rein spring holding the jaws shut on the spoke body until the tong jaw strikes the stop pin *S*. Again pulling the reins towards him, the operator drops the bent spoke, and opens the tongs ready to recommence the described movements, which have been thus minutely delineated because of the great rapidity of performance and the extreme accuracy of the bend produced.

From the bender the spokes go to the plating room; and from the plating room, where they are nickel-plated, some of them go to the enamel room, where they are put up in racks composed of two metal strips a couple of inches or so apart. The top bar of this dipping fixture has a straight row of holes only. The bottom bar has two rows, jointly containing the same number of holes as the top bar, so that when all the holes are filled, alternate spokes diverge to the right or left; so that when the spokes are dipped in the enamel, nearly to the crossing point of the spokes as they are laced in the wheel, the enamel-coated parts are so far separated as to certainly not interfere with each other in dripping and baking.

Fig. 120. BENDING HEADED SPOKES.

Fig. 121. FILLING SPOKE-DIPPING FRAMES.

The Lozier shops were totally destroyed by fire in November, 1894. The new shops built on the old site are well shown in Fig. 122. They are very large, in the L form, with separate shops in the rear angle of the main L—this separates the drop-forge shop and the enamel shop and the brazing shop from the main machine floors—the offices for foremen are in the towers; and the whole establishment is one of the most favorable examples of the multi-floored shops I have ever seen. The shops are narrow, well lighted, well heated and ventilated. The tools are in some classes Eastern, in some classes Western; a great many are by Pratt & Whitney, Brown & Sharpe, Garvin, Reed and other well-known Eastern names. The presses are by Bliss and the Ferracute and Toledo Machine & Tool Companies; the drillers for heavy work are mainly by Baker Bros., Toledo; the light drillers on the chain job are Barnes Bros.; the chain-riveting machines are by Addt.

The brazing room is of very late equipment; in fact, the first of its exact type; and I expect to describe it in particular detail. I do not think it superior to the Columbia brazing room; but it is a close rival for first place among all the brazing rooms so far seen.

The screw machines at the Lozier are by Pratt & Whitney, as are also the screw machines (Hartford Screw Machine Company type) at the Lozier screw-machine workshops in Thompsonville, Conn., where the principal part of the Lozier screw-machine work is executed. This Thompsonville shop has a curious history, and shows pointedly the influence of a small gage limit on screw-machine practice.

Taken altogether, the Lozier is a representative American cycle shop, and will be largely drawn upon in these papers to exhibit cycle-shop practice under the favoring conditions of thoroughly-trained shop management, unlimited capital and a very high-grade production mark.

The Lozier shops are said by cycle trade gossips to represent a total outlay of a million and a half of dollars as they stand. Mr. Lozier, of Cleveland, is the principal stockholder; Mr. Moore, originally from the old Ames shops, Chicopee, Mass., is the manager; Mr. Burwell, inventor of the "Cleveland" cycle chain, is superintendent; and Mr. W. L. Gleason, for many years in charge at the Elyria, O., Machine Screw Works, is the first assistant superintendent of these elegant Lozier shops. These men have set for themselves the task of making as good cycles as they can possibly produce, regardless of everything but quality and public approval. They, of course, believe that commercial success will follow the attainment of their mechanical ideal.

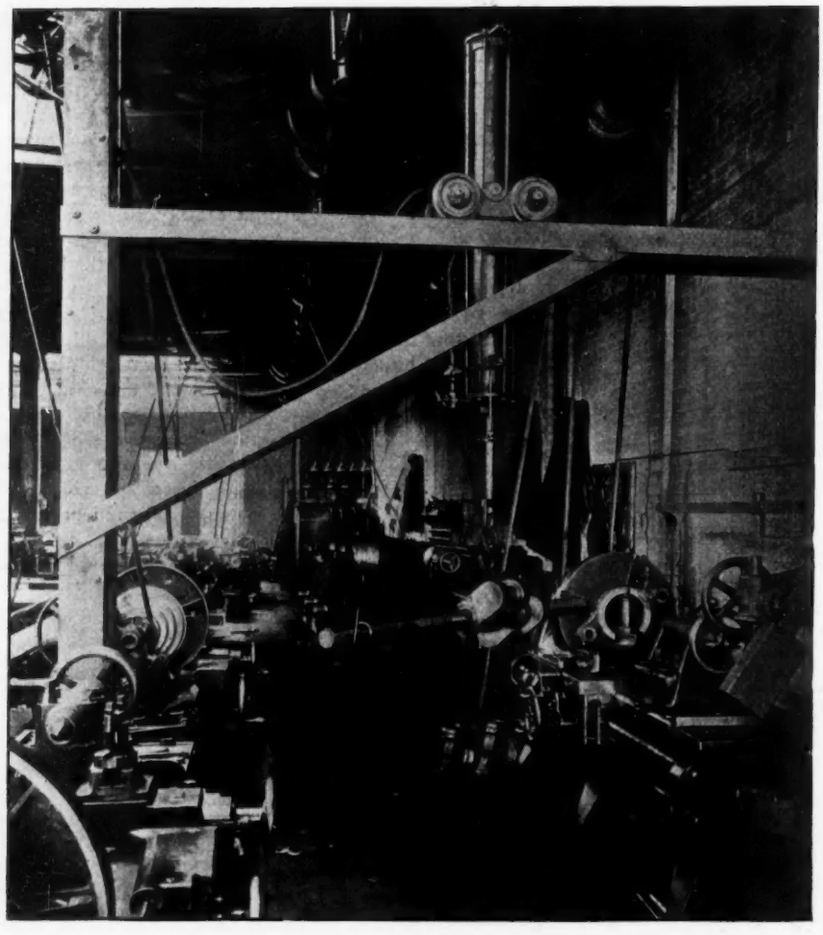
HUGH DOLNAR.

Will our correspondent who writes from "Derby City" please inform us what State he is located in. In the Post Office Guide there are about fourteen Derbys but no Derby City.

A Pneumatic Crane in a Machine Shop.

We show herewith a familiar-looking machine-shop interior, reproducing it for the purpose of calling attention to the pneumatic crane. The crane is so placed as to command the two lathes on the left, one lathe on the right, and a mandrel press in the extreme right foreground. The crane is shown suspending a double crank shaft going into the right-hand lathe.

The shop is fortunate in the fact that it has distributed through it a constant supply of compressed air. It would not be far out of the way to say that the air supply is furnished and maintained without cost or care. An air compressor is placed down in an out-of-the-way corner, and driven by a belt, automatically stopping and starting itself as the pressure fluctuates, and requiring no attention except an occasional filling of the oil cups. As to the power required, it is not worth speaking about, as one certainly would not say anything about the power required if putting in an additional drill or planer or lathe, and the compressor in this case probably requires no more power than any one of several tools in the shop.



AIR HOIST IN A MACHINE SHOP.

The crane post turns upon ball bearings, and the upper end is provided with vertical friction rollers; the trolley wheels also have friction rollers, so that the hoist may be run in or out upon the beam, and the crane may be swung around with perfect ease, whether carrying a load or not. The hoist cylinder swings upon trunnions, so that, when hoisting, the lift will always be in a direct line, and the operator is not required to give any attention to getting the cylinder vertical. When ready to hoist or lower, the valve string is pulled clear over, the openings being so adjusted that only a reasonable speed of hoist will be attained, and the work will never either rise or drop with any suddenness. A stop is provided for hoisting, and when the load reaches the desired height it stops automatically. If it is necessary to sustain the load for some time, the automatic stop also takes care of it, as if the load should descend slightly, on account of the leakage of the air, it is at once automatically restored to the desired height.

The crane and the compressor spoken of are in the shop of Pedrick & Ayer, at Philadelphia, and are made by that firm. Numerous hoists and various other compressed-air appliances are distributed through the establishment. The Messrs. Pedrick, senior and junior, are enthusiastic believers in the value and wide adaptability of compressed air, and are doing excellent service in promoting its general adoption, especially by providing excellent and various apparatus for this special use.

Some Ancient Drawing Instruments.

BY W. F. DURFEE.

Some time since (January 23d), I described in these columns a screw-cutting lathe invented by Jacques Bessoni prior to 1569; but this was only one of his sixty inventions. Among them are several drawing instruments, of which we have translated the descriptions of the three following:

Bessoni states that Fig. 1 (Fig. 3 in his book) is "A new pair of compasses and a universal delineator. I undertake, by means of pyramids, and bodies of similar shape bounded by straight lines, to make plane figures bounded by curved lines.

"These are a pair of compasses of most excellent parts. In the East is the first leg, extending from North to South; the Southern extremity having three points upon which rests a pyramid whose Northern base is a rectilinear equilateral triangle—these parts are stationary, but about this fixed leg, when the compass is used, quadrilateral and other multilateral figures may be delineated; but several pyramids will be necessary for drawing various-shaped figures.

"Behold the structure of the remaining joint or moving part of the machine. The Northern bar or arm is about six inches long and turns about the fixed leg, and is distant from the marking point about five and one-half inches, and parallel with the Southern bar, and these two bars guide the Eastern bar, the Southern bar sliding through the Western, and the Northern end of the Eastern bar sliding along the Northern bar to which the Western bar is fastened.

"Across the middle, between the two arms of this moving frame, is a square bar fastened to the Eastern bar and sliding through the Western, and having at its Eastern extremity a roller; and by turning this frame and its roller around the large pyramid in either direction, the moving marking points (which are at the lower ends of all the bars extending towards the North, and can be removed or replaced) describe figures bounded by regular arcs; the Eastern point describing a figure of the exact proportion of the section of the pyramid against which the roller turns. The marking points describe larger or smaller figures, according to the position of the pyramid; but it is to be noted that the medium-sized figures are always made by the central point."

The description of most of Bessoni's inventions is more or less incomplete, and in the above account he makes no

mention of the function of the very elaborate *E* spring, evidently intended to keep the roller in close contact with the surface of the pyramid. This drawing instrument is of especial interest, as being

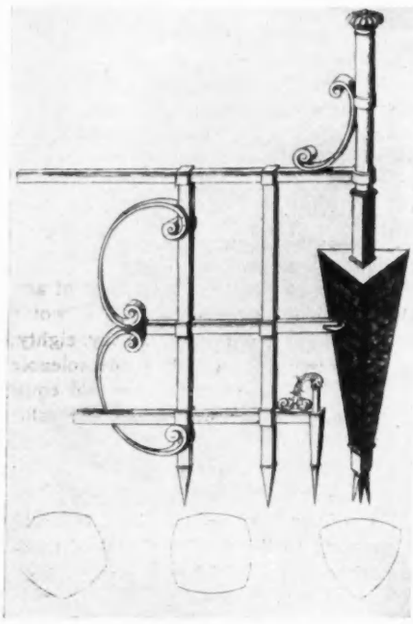


Fig. 1. ON THE PRINCIPLE OF THE BLANCHARD LATHE.

one of the first mechanisms designed for mechanically reproducing a pattern; and the principle involved is clearly that

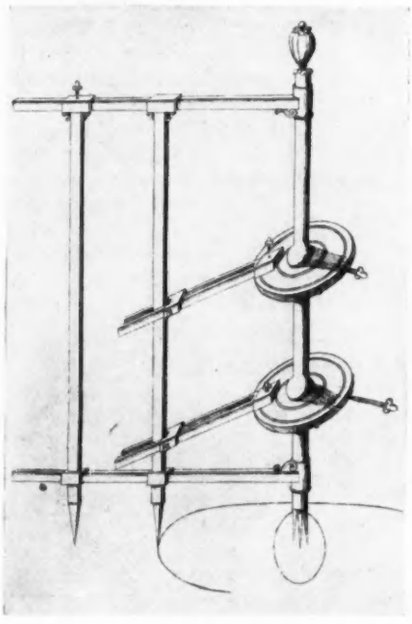


Fig. 2. DRAWING ELLIPSES

underlying the celebrated "Blanchard lathe."

In Fig. 2, (Fig. 5 of Bessoni) we have another drawing instrument, which is believed to be the first mechanical method proposed for describing an ellipse. Bessoni calls it "A new compass and universal delineator, by which an oval figure of a longer or shorter diameter, as large or small as you please, may be described.

"This compass has certain parts in common with others, viz., a stationary leg, long turning arms, and two parallel bars extending from South to North; but the other parts are as follows:

"Between the Southern arm and the upper similar and parallel arm there are fastened to the leg two globes, the first six inches, and the second three inches above the points. About these globes turn freely two flat disks, in the middle of whose thickness a screw appears, which penetrates their interior and fastens them solidly, and both disks are provided with guiding ribs. In the middle of both disks cavities are carefully formed, in order that their upper and lower parts may have a firm bearing upon the globes; and there are circular dovetailed grooves in the top of each disk, in which are fitted curved blocks free to move about the fixed leg. To the curved blocks in the circular disks are attached two similar parallel bars having their central portions cut away; these bars freely move backward and forward the vertical central bar, to the lower extremity of which is attached a marking point. The Western bar, which has a screw to confine it, is designed to strengthen the machine.

"Now, if this machine be turned about its immovable guides, the marking point will describe an oval; because when the flat disks are so adjusted that one side is lower than the other, the horizontal projection of their circular guiding grooves will be an ellipse.

"By diligent investigation it will be easy to understand the matter."

It does not require much "diligent investigation" to decide that, like most primitive mechanisms, this is a very clumsy device for the purpose intended; and furthermore, if constructed in accordance with the drawing, it would not be satisfactory in operation.

Bessoni also invented a compass for drawing spirals, which is shown in Fig. 3 (Fig. 6 of his work). Of this he says: "As I have formerly described several compasses, I will now explain another which I have invented for drawing spiral lines in a plane, such as have been made by unwinding strings and by other artifices:

"In the South is shown the whole of this machine. In the North are its parts, which I will describe. The round, long and hollow piece—which, if you please, is similar to the barrel of a gun—is the case, on the West end of which is a point about which the compasses turn when describing a spiral. The next is a screw, connected with which is a rod on whose Western end is the moveable marking point. The other parts in the North are interior screws, which can be substituted in turn for that in the case for describing various kinds of spirals. To the East end of the screw is fitted a wheel having teeth on its rim. The stationary foot of the compass is at one extremity and a square threaded screw in its interior.

"When all the parts of the compass are adjusted, the wheel (which holds up one end thereof) attached to the screw turns

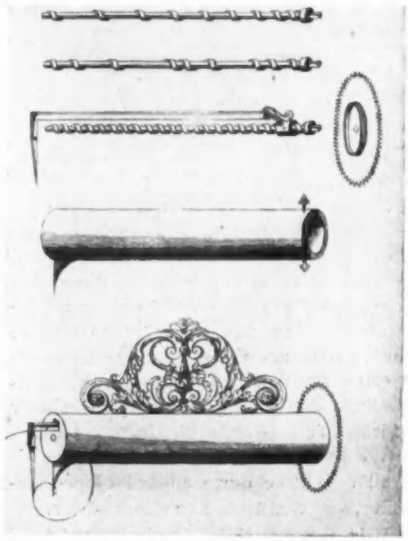


Fig. 3. FOR DRAWING SPIRALS.

and gradually protrudes the rod sliding in a square groove in the upper part of the barrel, and carrying the marking point.

"Which is the proposition."

Fig. 4 represents a drawing instrument invented by Nicomedes (a geometer who lived about 2,000 years ago) for delineating a peculiar curve called a "conchoid," discovered by him.

This instrument consists of two flat bars *A B*, *C D*, firmly fastened together at right angles. In the upper surface of the bar *A B* a groove is formed, in which slides a pin *F*, attached to a third bar *G H*,

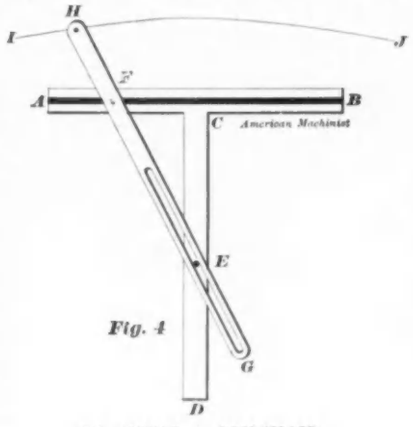


Fig. 4

DRAWING A CONCHOID.

in which is a long slot for receiving the stationary pin *E*. At the upper end of this bar is a pencil or marking point *H*, which is caused to describe the curve (conchoid) *I J*, by moving the pin *F* along the groove *A B*. This curve has been used for the "entasis" or swelled cutting of the vertical section of columns.

ELECTRICAL MACHINERY.

Electrotechnics—IX.

The Principles of Electricity for Practical Men.

BY FRANK S. MASON.

23. THE VALUE OF μ. This symbol like π (Pi) is a Greek letter and is pronounced "Mu." It has been used in equation (9), section 20, and elsewhere, to represent permeability.

Since iron in some form is the only material of commercial importance employed as a magnetic conductor, we need consider only air or iron as comprising the magnetic path. We know that the electric current produces a magnetic flux through air, and the same current a much greater magnetic flux through iron. This result is due to the greater permeability of iron as compared with air.

We have agreed in section 18, that air shall constitute our standard of permeability, and that therefore in air $\mu = 1$.

If in any magnetic circuit created by a particular magneto-motive force, iron is introduced in place of air, and as a result the magnetic flux is increased fivefold, evidently the permeability of the iron is in this particular case five times as great as that of air. Or put in another way, the reluctance of the iron is but one-fifth that of air.

In this case $\mu = 5$.

μ, therefore, for any substance is a numerical coefficient of the ratio between the flux density produced through air, the standard medium, by a particular magneto-motive force, and the flux density produced through the substance in question by the same magneto-motive force.

The flux density through air varies directly as the magneto-motive force. But with iron the flux density does not increase as rapidly as the magneto-motive force.

Were it not for this fact, the value of μ once determined for a particular brand of iron would be constant for any magnetizing force to which the iron might be subjected; but as it is, the matter is not so simple as first appears.

We have agreed in section 19 that the magneto-motive force shall be expressed in terms of the number of lines in the magnetic flux, just as we may state the capacity of a pump in gallons, both being based on certain understood premises.

We have also agreed that M shall represent the total magneto-motive force of a magnetic circuit.

In order that the value of μ shall bear a proper relation to the units of length and area in equation (9), section 20, where

$$R = \frac{l}{A\,\mu}$$

we have to divide the total magneto-motive force M by the length l, and to the resulting value the symbol H is assigned.

Briefly, by equation,

$$H = \frac{M}{l} \qquad (14)$$

or, substituting the value of M found in (8)

$$H = \frac{1.257\,C\,S}{l}$$

A magneto-motive force H generates H lines of force per square centimeter in air, against a resistance due to a length of one centimeter.

Next, we require a symbol to represent the magnetic flux itself, and for this purpose we will use the letter B.

In air, B is equal to H.

Do not confuse H, which is the magneto-motive force expressed in terms of the results it can accomplish—viz., lines of force per square centimeter in air as above—with B, which is the result itself in any medium.

That would be like mistaking the pump for the water it delivers, simply because we say it has a capacity of so many gallons.

To illustrate, let us assume that as a result of the ampere turns per unit of length of a solenoid, we have a flux density through air of five lines per square centimeter through the space inclosed by the spiral. This represents numerically the intensity of the magneto-motive force H and the magnetic flux B.

In this case both H and B equal 5.

If we now insert an iron core within the spiral, the flux density, as we know, will be very much increased. If the core is of gray cast iron, the magnetic lines per square centimeter will increase, as shown by experiment, to, say, four thousand. This increased flux density expresses numerically the degree of magnetization of the iron due to the same magneto-motive force which produced but five magnetic lines per square centimeter in air.

In this case H is equal to 5, and B is equal to 4,000.

Now, the permeability of the iron is evidently in proportion to the results produced by the magneto-motive force acting upon the standard medium, air, and that produced by the same force acting upon the iron.

Expressed by an equation, we have

$$\mu = \frac{B}{H} \qquad (15)$$

or, substituting the figures assumed above,

$$\mu = \frac{4000}{5} = 800$$

In the first case, where B and H both equal 5,

$$\mu = \frac{5}{5} = 1$$

making clear why in air, as asserted, $\mu = 1$.

Had we inserted within the solenoid a core of annealed wrought iron, the magnetic lines per square centimeter would have increased to as many as ten thousand, in which case the value of μ would be

$$\mu = \frac{10000}{5} = 2{,}000$$

But had we assumed a number of ampere turns at the start, such as would have afforded a value to H of, say, eighty; then, upon inserting within the solenoid a core of gray cast iron, B would equal eight thousand, in which case the value of μ would be

$$\mu = \frac{8000}{80} = 100$$

Or had we assumed a value for H of, say, three hundred and fifty, and inserted a core of annealed wrought iron, B would have risen to the neighborhood of nineteen thousand, in which case μ would be

$$\mu = \frac{19000}{350} = 54$$

Thus, we find μ to vary through a very wide range with the material constituting the path of the magnetic lines, and with the degree of saturation due to the magneto-motive force. The question arises, How shall we know what value to assign to μ when about to design an electro-magnet? The answer is, that it can only be known through an experimental investigation of the properties of the particular material the use of which is contemplated. It is not necessary here to enter upon a description of the various methods by which the desired results may be accomplished, since, as noted, various scientists have tabulated the results of their researches, and a reference to Tables II and III (by Hopkinson) following will discover the figures above quoted:

TABLE II.

GRAY CAST IRON—B AND H PER SQUARE CENTIMETER.

μ	B	H
800	4,000	5.
500	5,000	10.
279	6,000	21.5
133	7,000	42.
100	8,000	80.
71	9,000	127.
53	10,000	188.
37	11,000	292.

TABLE III.

ANNEALED WROUGHT IRON—B AND H PER SQUARE CENTIMETER.

μ	B	H
3,000	5,000	1.66
2,250	9,000	4.
2,000	10,000	5.
1,692	11,000	6.5

μ	B	H
1,412	12,000	8.5
1,083	13,000	12.
823	14,000	17.
526	15,000	28.5
320	16,000	50.
161	17,000	105.
90	18,000	200.
54	19,000	350.
30	20,000	666.

These tables represent but a very small portion of the data available, bearing on all kinds of iron, steel, etc., from manganese steel having a maximum value for B of three hundred and ten; nickel (not nickel steel) at ditto for B equal to about five thousand; to as high as B equal to forty-five thousand by Ewing, and sixty thousand by Du Bois for best annealed wrought iron—these two latter results being accomplished through employing enormously high magnetizing forces, and a special modification of the form of the magnetic circuit.

Nevertheless, every manufacturer of dynamo electric machinery should subject his magnet core material to a series of tests, and obtain his own figures, for the reason that there is such a great variation in different irons and steels and under different conditions. A description of a practical method by which this result may be accomplished may be incorporated in these notes.

Testing Motor at the Newton Machine Tool Works.

A new application of the electric motor is shown in the accompanying illustration.

It will be seen to be a motor in combination with an Evans friction cone mounted with the starting resistance box on portable skids. Its use is for testing machine tools before shipment.

As is well known, the Newton Machine Tool Works construct large and heavy tools, the testing of which has heretofore been a considerable item of trouble and expense. The position most convenient for erection was frequently not the most convenient for testing; and by the old method, testing frequently involved moving the machine or putting up a special countershaft, and, in any case, piecing and splicing of belts, with a lot of lost time. With the arrangement shown, the motor is simply picked up by the crane and taken to the machine to be tested a few minutes only being consumed in getting ready for the test.

The motor is of seven horse-power, and the Evans cone gives a range of speeds to the driving pulley from 165 to 685.

The appliance is said to have paid for itself in a very short time.

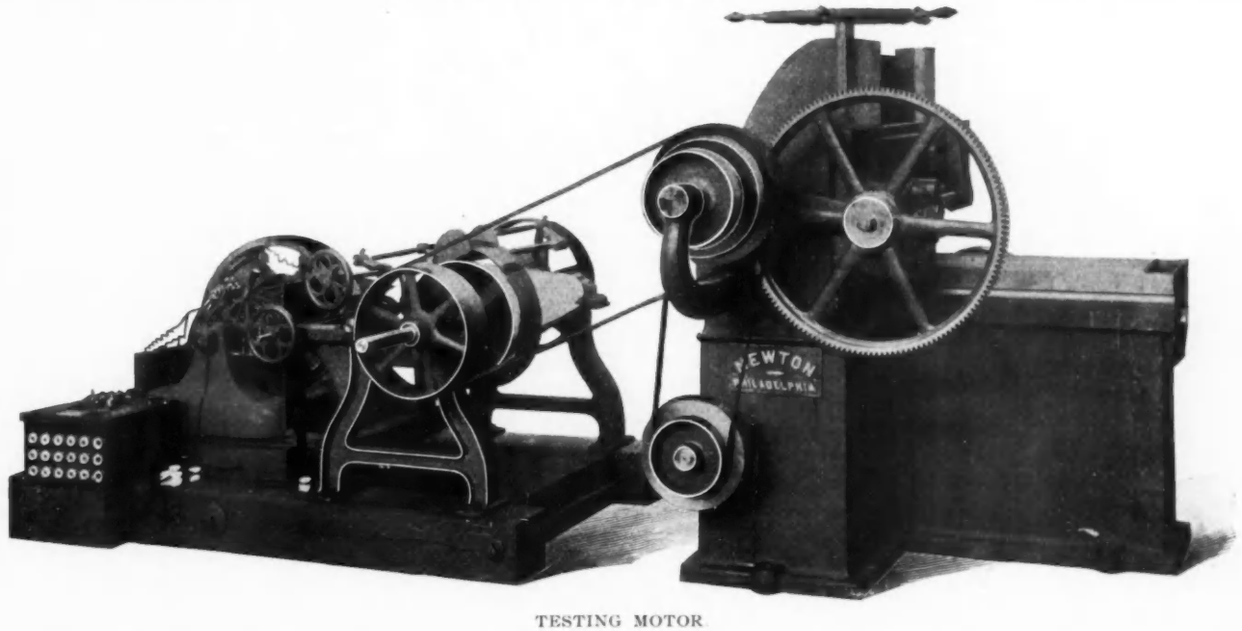
The Relative Merits of Drum and Ring Armatures, Considered from the Standpoint of the Users of Electrical Machinery.

BY WM. BAXTER, JR.

In Two Parts—Part I.

The question of the relative merits of drum and ring armatures has been very thoroughly discussed, but nearly all that has been written on the subject has been in the nature of arguments to show the advantages of one style of winding over the other, with regard to the electrical efficiency and cost of construction. Now, the merits of these two styles of armature winding may be considered from three different standpoints: First, as to their relative electrical efficiency; second, as to the cost of construction; and third, as to the liability to get out of order when in use, and the cost or repairs, as well as the time required to make the same. The second standpoint interests the manufacturer only, but the first and third are of vital importance to the user.

When a man purchases an electric motor, or a generator, he will look into the question of its efficiency very closely, if he is guided by proper engineering skill, because on this point will depend the cost of operation in the future. If a generator, low efficiency will mean heavy coal bills; and if a motor supplied with current from a central station, low efficiency will mean large bills for electric current. Electrical efficiency alone, however, will not determine whether one machine is more desirable than another. If a highly-efficient machine is so constructed that it will frequently get out of order, the cost of repairs, and the loss of time while such repairs are being made, may more than offset all the gain in running expenses. Therefore the question of durability is of just as much importance as that of efficiency. Not only is the question of durability of vital importance, but also that of the ease with which repairs can be made whenever they become necessary. In point of efficiency there is very little difference between the machines of any of the best makers; in fact, between the best and the poorest the difference is small. The truth is, that it is really difficult to make either a generator or a motor of low efficiency that will work well; it is easier and cheaper to construct machines of high efficiency. On this account there is not much danger of a purchaser making a mistake in this particular, even if he has no knowledge whatever of electrical matters. This, however, is not the case when we come to consider the question of durability, as well as the ease of making repairs.



TESTING MOTOR

Taken as a whole, an electric machine is remarkably durable, and the cost of maintenance very small. There are only three parts that can really wear away—these are the two journals and the commutator. The shafts in nearly all machines are made of steel, and in some are even hardened and ground. Therefore the wear in the journals takes place mostly on the boxes, and these, being interchangeable, can be replaced in a few minutes and at small expense when worn out. The commutators, if they run without sparking, should last several years; but as they cannot be replaced so easily, it is desirable that they should be so made as to have a considerable amount of available wear.

As there are virtually only three parts that really wear out, it might be supposed that the renewal of these parts would be all that would be required to keep the machine in perfect running order. But experience shows that such is not the case. The principal cause of delays, and the largest item in the cost of repairs, is that of armature burn-outs.

Those not familiar with electric machinery might consider it strange that a part of the mechanism that is subject to no apparent wear should be the source of more trouble than those parts in which deterioration is self-evident. But when we investigate the construction of an armature, we will find that while in operation it is subject to a constant, although invisible, action that must sooner or later cause it to give out.

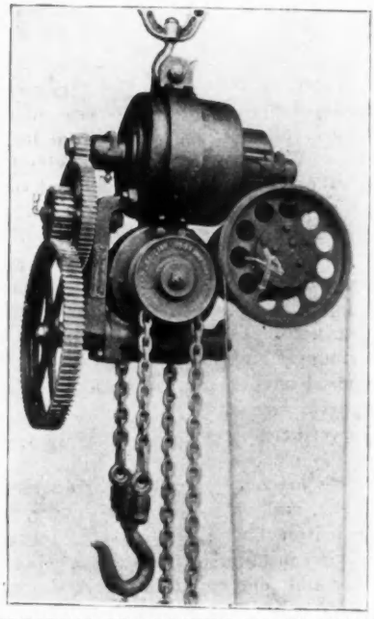
The principal cause of trouble with armatures is, that the insulation gives away; either that which separates the wires from each other, or that which separates the entire body of wire from the core of the armature. From this it follows, therefore, that the most desirable construction is that which will reduce the deterioration of the insulation to a minimum amount. In order to determine this point, it is necessary to investigate the causes by which the insulation is destroyed; then we can judge whether these causes are greater in one form of armature than the other.

Starting with the insulating material, we will find that for covering the wire cotton thread is used; and that the insulation for separating the sections of wire from each other and from the armature core, is composed principally of the same material, either in the form of cloth or paper. In most cases, either mica or asbestos is used in connection with the paper and cloth, but in no case are the latter wholly discarded. Now, cotton fiber will in time lose its strength if subjected to the action of heat; and, instead of being tough and elastic, will become brittle and easy pulverized. In an electric motor or generator the insulation is subjected to the action of heat all the time the machine is in motion; therefore, from the time when it first begins to run, the insulation begins to deteriorate. If the wire could be held perfectly motionless and free from strains of every kind, an armature could be depended upon to run for an almost unlimited number of years before giving out, because the action of heat alone is not sufficient to produce serious results in a short space of time. This is demonstrated by the fact that field coils never give out by the gradual failure of the insulation. Whenever they do burn out, it is on account of being overheated by an increase in the current, or through becoming saturated with oil impregnated with metallic particles, or else through external injury.

Such a thing as quiescence in the wire wound on an armature is not obtainable. In the first place, the centrifugal force tends to throw the wire off in a tangential line; in the second place, the action of the magnetism is to either pull the wire around in the direction of rotation, or else to impede its motion, according to whether the machine is a motor or a generator. Finally, the action of the heat generated by the current is to lengthen and contract the wire. Under these various actions, it will be seen that motion is imparted to the wire longitudinally and transversely.

The strain that the action of magnetism brings to bear upon the wire is very often overlooked, owing to the fact that the great majority of men, even among electricians, consider that, in the case of a motor, the attraction between the poles of the field magnets and the poles of the armature is what causes the rotation, and that in the case of a generator the repulsion between these poles resists the rotation of the shaft. Taking this view of the case, the assumption would naturally be that the wire was simply carried around subject to no other strain than that due to centrifugal force. This, however, is not the true explanation of the action. As a matter of fact, the wire has to transmit the whole energy of the machine. In the case of a motor, the magnetism of the field pulls the wire on the armature around, and the power given off at the pulley is proportional to the force with which the wire is pulled around. In the case of a generator, the magnetism of the field pushes back the wire on the armature, so to speak, and resists its rotation. In former days, before the mechanical construction of electrical machinery was as perfect as it is to-day, it was not an uncommon thing for the wire on an armature to become loose on the core, owing to the fact that it was not secured strongly enough to withstand the strain. In such cases, if the machine happened to be running under a heavy load, the wire would stand still while the core within would continue to rotate at full speed, and the friction between the two parts would soon raise the temperature to a point that would set fire to the insulation.

Inasmuch as the transverse strain on the wire is very great, it follows that the best form of construction is that which will hold the wires most securely in place, and also leave the least possible space within which vibration may take place.



ELECTRICALLY-DRIVEN CHAIN HOIST.

Electrically-Driven Chain Hoist.

We illustrate herewith an electrically-driven chain hoist which has just been brought out by E. Harrington, Son & Co., of Philadelphia, Pa.

The illustration is almost self-explanatory, but it may be stated that the motor is placed in the iron casing shown at the top, and is dust and moisture proof. The controller is placed behind the rope wheel as shown. The load is lifted, stopped, lowered, and the speed of hoisting controlled by the hand rope shown.

The hoist will easily lift 10,000 pounds at a maximum speed of 5½ feet per minute, which is at least five times the speed possible with such a load when using hand power. Smaller loads are, of course, raised faster. The lowering speed is 10 feet per minute. The labor of hoisting is, of course, practically done away with.

There is, no doubt, a large field of usefulness for a hoist of this type.

The Present Status of the Storage Battery.

Editor American Machinist:

In your article in the January 16th number on "The Present Status of the Storage Battery," I noticed that you discovered the error made in our discussion at the American Institute meeting, and I beg to state herewith that this error occurred in the hurry of preparing the paper, as we were notified only just before the meeting of the matter to be under

consideration. The errors are at present corrected in the "Transactions," and I would like to let you know how the correction reads. The cost of fuel without accumulators, has been multiplied by $\frac{8}{10}$ to reduce to the average for the day, while .16375 remains as the ratio for the year. But the cost of accumulators, on the other hand, was overestimated, as surely any manufacturer would allow more than 6.6 per cent. on the list price; if, instead, 33 per cent. were allowed, the comparison would stand as follows:

Without Accumulators.	Annual Cost.
Fuel	$28,000 00
Labor and superintendence	50,370 00
Supplies and repairs	10,810 00
Interest and depreciation on steam plant	113,280 00
Interest and depreciation on electric plant	39,500 00
Total	$241,960 00

With Accumulators.	Annual Cost
Fuel	$13,820 00
Labor and superintendence	30,660 00
Supplies and repairs	5,550 00
Interest and depreciation on steam plant	46,780 00
Interest and depreciation on dynamos and accessories	17,742 00
Interest and depreciation on accumulators	78,000 00
Interest and depreciation on accumulator fittings	10,920 00
Total	$203,476 00

These are the corrections as made in the "Transactions," It is true, however, that though in Europe savings are made without doubt by accumulator regulation, circumstances here may lead to the reverse; but the benefit which may be derived from our discussion will consist in learning on what lines a calculation for the advisability of accumulator regulation should be made, after the prices of the different items at the place under consideration are obtained.

F. J. DOMERQUE.

[Our criticism of Messrs. Abbott & Domerque's contribution to the storage-battery discussion, was directed to the estimate of the average horse-power for a plant with accumulator, which appeared to be altogether too low In Mr. Domerque's letter, which we publish above, he does not raise the estimate of power for the accumulator plant, but, on the contrary, reduces that for the plant without accumulator, by introducing the factor $\frac{6}{10}$. He does not explain, and we are unable to see, the origin of this factor. On the contrary, the original paper, as published in the "Transactions of the American Institute of Electrical Engineers," stated that "It has been ascertained by Mr. Fritsche that the average load throughout the year is 16.375 per cent. of the maximum load," from which, if we read it straight, the original determination of the horse-power for a plant without accumulator was correct.—Ed.]

LETTERS FROM PRACTICAL MEN.

Scholarships in Cornell University.

Editor American Machinist:

I have been a reader of your valuable paper for the past five or six years, and never before have I seen an article in its columns that shows such a lack of knowledge of its subject as does the one in your last issue, entitled "High Admission Requirements in Engineering Schools." Inasmuch as it deals with Cornell University, I wish for my own information that you would enumerate the amounts of a few of those "large public endowments" of which your article speaks.

I will say from personal experience, in contradiction of your statement that Cornell is "becoming more and more a school for the education of the rich men's sons," that any poor boy or girl, a resident of New York State, with the average academic education, can, by availing himself of the opportunity offered by a free State scholarship, enter Cornell University, and on entrance be eligible to take the examinations for a university scholarship—of which there are a number—which gives him $200 cash a year.

I will not write further on this subject, but refer you to the inclosed pamphlet, which address I was fortunate enough to hear, for a further expression of my sentiments; and trust that you will read the same and enlighten yourself, so that you may publish another article and give to Cornell, your so-called "State University," its just, deservable credit.

J. M. KINGSBURY.

[The pamphlet sent by our correspondent is an address by President Schurman, entitled "Grounds of an Appeal to the State for Aid to Cornell University," and is one with which we were already familiar. Our correspondent does not seem to consider the proceeds of the land grant as public funds, but we are unable to see any essential difference between a grant of money and a grant of real estate from the public domain. The extent of the proceeds of this grant is, of course, largely due to the devotion and management of Ezra Cornell—a management which involved his private fortune, and which eventually carried him to an untimely grave. As a result of Mr. Cornell's sacrifice, the university has realized upwards of five million dollars from the public land grant, which sum makes it the institution that it is. The State scholarships referred to by our correspondent are the return which the university makes for this grant. In this it is simply carrying out a contract which it was anxious enough to make at the beginning, and for which it has received a full equivalent. We are not so foolish as to ignore or belittle this splendid system of State scholarships, nor the generosity with which the university has supplemented them with additional university scholarships. Praiseworthy as they are, however, they have not been able to counteract the rising tide of wealth among the students. The fact that the student body is not the democratic assemblage it once was, is conceded by practically all of the better-informed of the older graduates. Our original editorial on this topic did not, however, take up the question of help to students, and we have not criticised the present methods of extending help. What we urge, and all that we urge, is that the admission requirements be made such as to admit to the work in mechanical engineering those best able to profit by it, which, it is needless to say, are those who have shown their love for mechanical pursuits by adopting the overall uniform with the accompanying labor and grime of shop work.—Ed.]

Reamed Hole Smaller Than Reamer.

Editor American Machinist:

In reply to Otis Worth, as to how it is possible to ream a hole in cast iron, and obtain as a result a hole smaller in diameter than the reamer used, I will explain why this can be so, as it may seem strange to others, for a reamer will often cut larger than itself. When a reamer does not cut its size, either the work must expand or the reamer contract in diameter. The latter is not likely with the pressure which is applied using it by hand. If we take a pulley with about a 2-inch hole bored to within about .005 inch of the diameter of reamer, let the hub of this pulley be somewhat long and about ½ inch thick; then, if the reamer is quite dull, the work will spring or expand from the reamer while it is being forced through, and will close in again when the reamer is removed.

If a reamer has been turned through a hole, as in hand reaming, and then put in again, and it does not go through by hand, it is evidence enough that the hole is smaller than the reamer, and I have known this to occur more than once on small work. J. T. G.

The Third Triangle for the Draftsman.

Editor American Machinist:

I think I have the triangle Tecumseh Swift is looking for. The angles are 25°, 50° and 105°. With it and the 30-degree and 45-degree triangles and T-square, the circumference may be divided into the 5-degree spaces he tells about.

R. P. KING.

Chicopee Falls, Mass.

The Third Triangle for the Draftsman.

Editor American Machinist:

After reading what Mr. Newton has to say in regard to the third triangle mentioned by Mr. Swift January 23d, I am prompted to say a word for it. Some seven years ago I broke one of my hard-rubber triangles, and having a large piece of one side left whole, I made a 10°, 80°, 90° triangle of it, about seven inches long; not that I had felt the need of such a triangle, but simply because I had the material. After using this triangle for seven years, I could not now get along without it. The 10° angle used with the 30°, 60°, 90° triangle enables one to divide the circle into thirty-six divisions; used with 45°, gives 35° and 55°; and the three triangles will combine to give any 5° division. A 20° angle would also divide the circle in the same way. The 80° angle of my third triangle is of little use, and I think the large end might better be a circular arc about the point and divided into ten divisions, to be used in the same manner as a protractor for intermediate divisions.

The use of this triangle is not to divide a circle into a number of parts, as required in laying out a gear wheel, but to get oblique lines making a known angle with the vertical or horizontal. For instance, when some part of a casting must "cope off," the 10° angle is about the proper thing.

To step off a large gear wheel into tooth spaces, the circle may sometimes be first divided into eight or ten divisions, and then these divided into tooth spaces. For example, to lay out a 117-tooth gear, first divide it into nine sections, and then step off each of these sections into thirteen tooth spaces.

JNO. D. RIGGS.

Janesville, Wis.

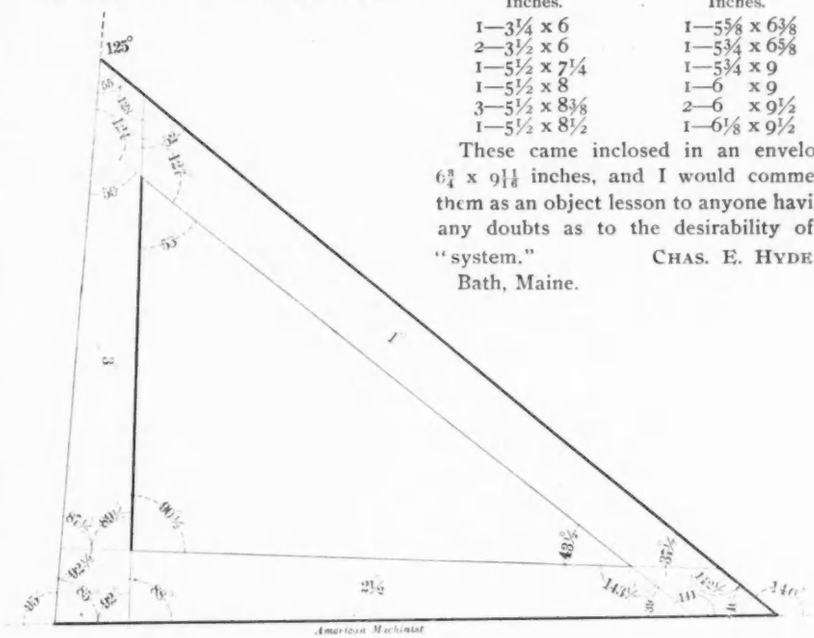
Editor American Machinist:

The third triangle shown herewith is only offered as a suggestion. It is "a" triangle, but not necessarily "the" triangle. It will be readily seen that, by the aid of even this one, more may be done than I suggested could be with a third triangle. It is by no means certain that the angles selected are the best that might be adopted, and one special line of work might call for a different selection of angles from those which would be most suitable for some other line of work. The principal angles of the triangle shown are 40°, 55° and 85°; while, including the complementary angles, there are upon it in all twenty-seven different angles. If the standard 45° and 60° triangles were made on the same idea, they could each carry three or four times as many as at present, and all, or nearly all, different from each other; while all three together would furnish a wide range of angles. It is not supposed that for dividing circles they would be much used, but for the occasional drawing of special angularities they would be handy. In any case, the suggestion is not a harmful one.

TECUMSEH SWIFT.

Editor American Machinist:

If those of your readers who are trying to discover the proper angles for a draftsman's third triangle, will try Brown & Sharpe's protractor, they will give up their search. This instrument is not properly appreciated among mechanical draftsmen, who seem to think that a protractor belongs to a land surveyor's outfit rather than to their own. In point of fact, outside the articles of necessity, there is no more useful addition to a mechanical draftsman's kit. It will, of course, give any angle between 0 and 90° (and, having a vernier, with great accuracy if required). Moreover, having no projections on either side, it may be used either side up, which, together with its own right angle, gives at one setting not only the angle set for, but its complement, its supplement and the supplement of its complement—a feature which is often of great convenience.



A THIRD TRIANGLE.

Its usefulness is, however, by no means confined to its intended use as a protractor. It is, in effect, a portable, adjustable, angular straight-edge, and as such it has many uses, such as transferring angles from one part of the board to another, and in making angular projections. It takes the place of a swivel head T square, in which capacity it will cover all parts of the board, which the swivel head will not, as when listed in a "southeast" direction it will not cover the "northeast" corner of the board. The protractor is also very useful when putting in projection and dimension lines of link work, or other pieces lying at an angle with the center lines of the main pieces. Moreover, it can be used successfully in those drawing rooms, which, like the Gates Iron Works, do not admit men having more than two hands.

C. K. JACKSON.

Standard Catalogs.

Editor American Machinist:

It would appear that there is a field for the promulgation of the standard catalog idea among publishers of school books.

I have on my desk a batch of circulars, sixteen in number, just received from one of the well-known houses in that line—made up, as to dimensions, as follows:

Inches.	Inches.
1—3¼ x 6	1—5⅝ x 6⅜
2—3½ x 6	1—5¾ x 6⅝
1—5½ x 7¼	1—5¾ x 9
1—5½ x 8	1—6 x 9
3—5½ x 8⅜	2—6 x 9½
1—5½ x 8½	1—6⅛ x 9½

These came inclosed in an envelope 6¾ x 9¹¹⁄₁₆ inches, and I would commend them as an object lesson to anyone having any doubts as to the desirability of a "system."

CHAS. E. HYDE.

Bath, Maine.

The Gates Drawing Room—Rolled versus Flat Tracings.

Editor American Machinist:

In my communication published in your issue of January 30th, I offered, under certain conditions, to apologize to Mr. Randol for my remarks on his Gates Iron Works Drawing Room article. I desire now to recall the conditions and apologize any way. I had no idea of insinuating that Mr. Randol and Mr. Carman had "put up a job" on your readers, nor did I intend to make any insinuations concerning Mr. Randol personally. My opening paragraph was intended as a bit of pleasantry, which I now realize was constructed with rather less care than is required to ride a bicycle, even after one has learned to do the trick, and with two hands on the bar.

In your issue of February 13th, Mr. Carman has occupied considerable space with an answer to my communication above mentioned; but he says nothing

about accepting my proposal to demonstrate in your columns the relative capacity of tube and flat storage of drawings. I am willing to accept the testimony of Messrs. Randol and Carman as to the convenience of using for reference, blueprinting, etc., in Chicago, rolled tracings in contrast with those which have been trained to lie flat. I do not yet believe that any drawing or tracing which has been brought up in Massachusetts in a close-fisted roll, would stay in sight long enough to be of use without being weighted or nailed down. A few experiments with a roll of tracings ought to settle this phase of the question for any intending user, fully as conclusively as it can be done here.

But it seems to me that the relative merits of the two systems of storage in regard to capacity—an important matter when fireproof vault storage room is considered, can be pretty conclusively shown by the competition I suggested to Mr. Randol. I wish therefore to extend to Mr. Carman a similar proposition, namely, that he send to the "American Machinist" figures covering the capacity of his tube storage vault, and that I do the same for my shelf-and-portfolio plan. I expect, of course, to prove the excellence of my shelf arrangement—which, by the way, is a plain, everyday sort of an affair, without any of the "frills or contortions" with which Mr. Carman says he decorated his trials of this plan, which possibly may have been in some measure responsible for the absorption of money and the results which he says accompanied his trials. I am, however, open to conviction; and if Mr. Carman can show the superiority of the tube plan, I will be the first man to acknowledge it; and, in any event, I shall be as glad to welcome him to Worcester, if he will come this way, as I should be to "entertain" Mr. Randol.

Worcester, Mass.

WM. L. CHASE.

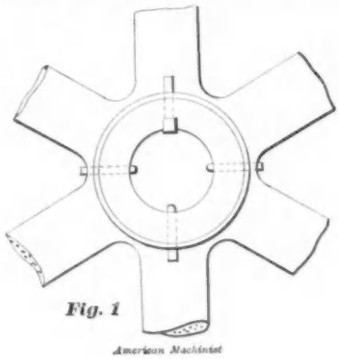
Fastening Fly-Wheels.

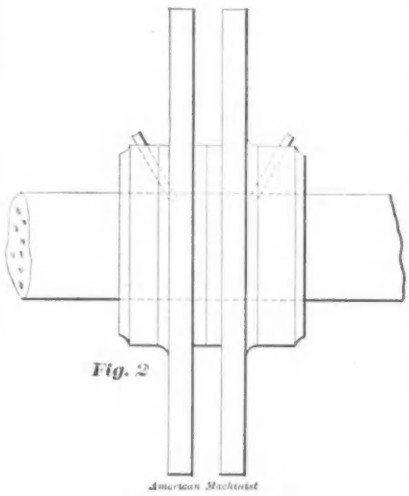
Editor American Machinist:

The subject of loose fly-wheels has attracted my attention for the last two or three years, and the attempts to make them secure have been interesting. The favorite means appear to be set screws.

If we take ordinary shafting and put a key between the hub of a driving wheel and the shaft, well fitted, and then put in a set screw, it is a rare thing that it will give trouble, and it seems that there are those who reason the same as regards fly-wheels. There is, however, a vast deal of difference between a wheel that simply rotates and one that is driven by a reciprocating motion. In the latter case the shaft drives the wheel, and then alternately the wheel becomes the driver. Under this condition it becomes necessary that the wheel hub should have a good grip on the shaft, and to have this the hub should go on the shaft tight. The shaft should be large, and the hub long at the fit, as a large bearing is a necessity.

One job that came up was a wheel on a high-speed engine that drove a line shaft from a clutch ring on the fly-wheel. When made, the shaft was turned down in the wheel fit, thus reducing the bearing on the shaft; and, also, the shaft did not extend through the hub of the wheel. Under this condition it could only be a question of a short time when the wheel would become loose. When it did, they put four keys on four sides of the shaft, and put in set screws on all the keys. The effect of this was to reduce the bearing





SET SCREWS IN FLY-WHEEL.

to the top surface of the keys, and then further reduce it to the point of the set screws; and, as a matter of course, the wheel commenced to run off the shaft. To overcome this, eight holes were drilled through the hub and into the shaft, and steel set screws with hardened points were screwed in.

After breaking two clutches, the owners decided that it might be profitable to have a new deal; so a new shaft and wheel were ordered with the hub as large and long as it could be made. Work was commenced at 12 o'clock at night to remove the wheel, and also the clutch on the end of the line shaft, with the intention of getting every thing ready to start at 4 o'clock that afternoon, the engine driving an electric lighting plant.

On account of using the old eccentric it became necessary to take off the wheel, and here the fun commenced. Two of the hardened set screws had their points broken off and the points stuck in the shaft, as was to be expected, and could not be removed. It became necessary to get jacks, and then with sledges came the long pull to get the wheel off. After it and the hub of clutch on line shaft were off, it was found that in both cases the bolts had been sheared off with but little abrasion of the hub of the wheel or the cast-steel shaft. It took so long, however, that the people in that town did not get their light until eight o'clock, which gave the electric company a bad record.

Another case was that of a loose wheel which the builders said they could tighten without trouble, but would not explain how for some time, until they finally learned that the method must be known or a new wheel must be made. They then said that set screws could be put in in such a way that it would make a perfectly tight fit. Asked if it was intended to put them in on four sides, as indicated in Fig. 1, they said it was. When it was explained that screws of that kind were in there now they gave it up, and admitted that nothing would do but a new wheel or a new shaft. This was finally settled by the shaft itself, which broke, and then the wheel was bored out and made all right.

There was a case where a segment wheel had not been put on sufficiently tight and got loose. The engineer contended that the only thing to do was to get a new shaft. Other counsels prevailed, and set screws were put in as indicated in Fig. 2. I don't know whether these set screws were hardened or not. It is unimportant, as they would break off in any case—only, if they were not hardened they could be drilled out; while if they were, it would mean more delay in getting the wheel off to put in a new shaft, which they were obliged to do at last. This wheel was forced on the shaft in the first place, and a feather, or straight key, that fitted on the sides only.

There are lots of wheels, especially on high-speed engines that do not run true, and the favorite method seems to be to pene them to bring them true. After a time they get to running out again, and the hammer is resorted to again and again, until it is a question if the arms are not broken off. When one sees a wheel all battered up at the base of the arms, he cannot help inquiring as to the character of the work done in the shop where the article was made. It is also noted that the shop that turns out wheels that require the use of a hammer to bring them straight, also has a good many loose wheels that are bolstered up with set screws, and then new wheels.

W. E. CRANE.

Stresses on Gear Teeth—Cylinder Clearance.

Editor American Machinist:

In a former contribution on the "Horse-Power of Gear Wheels" ("American Machinist," August 15, 1895) I gave a table by which the power of gears could be readily ascertained, and which permitted any desired intensity of stress on the teeth to be adopted. At the same time I gave some indication of the intensity of stress which is frequently allowed under different conditions of working, stating that, for uncut gears of cast iron stresses of from 1,600 to 2,800 pounds per square inch appeared to be reasonable values, but that for high speeds these values should be reduced somewhat.

Recently I have analyzed a number of cases of fairly high-speed main gearing; and while, as anticipated, considerable difference is found in the practice of different makers, the average stress allowed is quite confirmatory of the estimate above alluded to. Taking, as before, a tooth having a thickness = 0.4 pitch, and a length = ⅔ pitch, and assuming the load to be evenly distributed over the entire breadth of two teeth, the stress will be

$$= \frac{HP \times 33000 \times 2p \times 6}{v \times 2 \times 3 \times 0.16 p^2 \times b} = \frac{HP \times 412.500}{v \times b \times p}$$

f being the intensity of stress per square inch, p the pitch, and b the breadth of the tooth in inches, v the velocity in feet per minute, and HP the horse-power transmitted. This, of course, assumes that the load acts at the extreme point of the tooth, that the thickness of the tooth at the root is the same as at the pitch line, and that v is taken as the velocity of the tips of the teeth instead of the pitch line. All these assumptions are, of course, strictly unwarranted; but they can scarcely be held to materially impair an investigation in which so many of the conditions can only be conjectured. In any case, this approximate method of computing the stress will enable comparisons to be made between the practices of various makers.

I give below a few examples of recent mill gearing, with the approximate stress per square inch calculated by the foregoing method. As will be seen, the stress varies from 1,210 pounds to 2,220 pounds per square inch, while the average for the fourteen examples given is 1,800 pounds per square inch:

I notice that one of your contemporaries appears to have suddenly discovered that the actual loss resulting from the cylinder spaces in engine cylinders is far greater than the numerical percentage by which the amount of such clearance is usually designated. Probably few will find much enlightenment in this piece of information; but when, following this statement, we read that the loss is "nearly in proportion to the percentage which the clearance space bears to the volume of the cylinder at cut-off," it would seem that the writer has got a little out of his depth. Using, as an illustration, the case of an engine cylinder with a cut-off of 25 per cent., and a clearance of 5 per cent., the writer in your contemporary considers that this may approximately be taken to represent a loss of $\frac{5}{25}$, or 20 per cent.

FIGURES TAKEN FROM EXAMPLES.

Power Transmitted, I H. P.	Velocity, Feet per Minute.	Pitch, Inches.	Face, Inches.	Approximate Stress, Pounds per Square Inch.
220	1,337	4	10	1,695
277	1,705	3 5/8	9	2,050
350	1,702	4 1/4	12	1,665
390	2,570	4	13	1,210
560	1,770	5	16	1,620
700	2,120	5	15	1,820
700	2,475	4.4	18	1,485
800	2,000	5	16	2,060
800	2,116	5 3/4	17	1,575
880	2,500	4 5/8	17	1,850
936	2,366	5	15	2,180
1,100	2,406	5 1/2	18	1,910
1,130	2,242	5 13/16	18	1,985
1,150	2 323	5 11/16	18	2,220

As a matter of fact, however, the actual loss directly due to clearance can never be so great as represented. In the first place, the fraction of the cylinder volume filled with steam when cut-off occurs is, in the case cited, $\frac{20}{105}$, while the clearance is represented by $\frac{5}{105}$ of the whole cylinder volume. Thus, reasoning even on the above lines, the loss would be only 16.6 per cent., instead of 20 per cent. Beyond this, however, the fact is to be considered that during the expansion period the clearance steam is fully utilized, and the augmentation of the mean effective pressure thus resulting is another item to be set against the loss by clearance. Further than that, the clearance space at the end of the return stroke of the piston must be filled with steam of at least exhaust pressure, and the effective clearance is again proportionately reduced. Thus, if in the above case we assume a back pressure of 20 pounds and an absolute initial pressure of 100 pounds per square inch, the effective clearance will be reduced to about 13.33 per cent.

Then, again, with a suitable degree of cushioning, it is possible to profitably compress some of the exhaust steam so as to partially fill the clearance space, thus further reducing the loss; and although the intrinsic value of the latter gain is usually not great, it is likely that some indirect benefit results by reason of the compressed steam heating up the clearance surfaces before admission takes place.

There is, of course, no question that clearance is one of those necessary evils which it should be the aim of all designers to minimize as much as possible; but I quite fail to see that anything is to be gained by exaggerating the amount of this loss as in the manner above described.

M. E.

[The article referred to by our correspondent appeared in the "Engineering Record," January 18th. It is proper to say that some of the points which our correspondent mentions as against the writer of the article were, in fact, alluded to in it, but were not made use of except as mitigating suggestions.—Ed.]

Logarithms — Foote's Constant for Diameters.

Editor American Machinist:

In your issue of January 30th, page 141, in announcing your intention of soon publishing an article on the subject of Algebraic Formulas, you say: "We have no sympathy whatever with unnecessary or prolix mathematics." Ditto here. I do not believe in using unnecessary figures; consequently, in most calculations involving a large amount of multiplication or division I use logarithms. The knowledge of their use is so readily learned, that by one or two studious evenings almost anyone of good thinking powers can easily master at least their use. There ought not to be any "bugbear" about it, and I believe that your article on Algebra can be profitably supplemented by practical lessons on the use, if not the theory, of logarithms.

I believe it to be a fact that a large majority of otherwise first-class mechanics look upon logarithms as a "bête noire."

To one who knows the simplicity and advantages of their use in long calculations, involving multiplications and divisions, in working out "the rule of three" or proportions, and also in finding the powers and roots of numbers, logarithms become a tool which ought to be in the hands of every mechanic. A logarithmic table, being then only a tool, and a great labor saving one, its use for all ordinary every day calculations can be easily learned by any person of ordinary mental capacity; so why are so many people afraid to tackle the job?

I will tell the reason why, and I speak from my own experience.

There is not, to the best of my knowledge and belief, any teacher in the common or high schools of our land, nor any text-book published in the English language, but starts the learner off, by trying first to teach him the whole theory and science of logarithms, and this I know is extremely difficult to comprehend and when one does, after considerable study, begin to get a faint insight into the theory of exponents, it usually takes greater study to begin the construction of a table. All this time the student is learning nothing of the practical uses of logarithms, and generally gives it up as a bad job, "not worth the candle," before he begins to have the faintest glimmering of their

practical use as an aid in lightening tiresome brain drudgery.

As well might a person bring up his child to the use of bread and butter, by first requiring it to learn the whole chemical analysis of wheat, the whole mechanical manipulation to convert it into flour, the whole chemical science of fermentation and baking, and the mechanical operations of kneading the bread; then start in on the butter and teach the child the whole chemical and mechanical science of butter making, with the strict injunction that until all these were thoroughly learned, no bread, no butter. I think that under these circumstances, the ordinary every day child would grow up in the firm belief that he did not need bread and butter, and that it was no good any way, he would rather have pie.

In point of fact, the preliminary study of the theory of logarithms is as superfluous as that of bread and butter. All that is required (and this cannot be had in any published text book apart from the theory) is an explanation of what a table of logarithms is, and how it is used. I once learned this theory, but never having had occasion to use this knowledge in practice, I have practically forgotten all about it, and do not now care about relearning, although I do have frequent occasions for the use in my work, of this valuable time and brain saving tool.

This subject puts me in mind of a problem which machinists are often called upon to solve in practice. That is: Given the circumference of a circle, what is its diameter?

Take your "Haswell" or "Trautwine," if you do not remember, and you will find these rules. "Divide the circumference by 3.14159 +, or, as 355 is to 113 so is circumference to diameter. The rule usually remembered and used is to divide the circumference by π (P1) = 3.14159 +, to be true to five decimal places.

Now, I have a rule which is unquestionably old, but I never saw it in print—never ran across it, to my recollection, in any mathematical work or text-book on engineering. It may be in many of them, but I believe that few know it, so I will give it for the benefit of your readers: Multiply the circumference by the constant 0.31831. These figures are easily kept in mind.

Take, as an example, circumference = 24 inches, feet, yards, meters or miles. The calculation by the usual method requires 101 figures; by the method I suggest, 25 figures. In the first working I illustrate a method which I frequently use—in fact always when I have many figures in my divisor. I find it a great help in long division, and believe that many of your readers may also. I set the first figure of quotient in front of the first product, second figure of quotient in front of the second product, etc., etc., in the manner shown. Then when there comes a recurring figure in quotient, I do not have to go through the multiplication again (see last two multiplications 4 — 4 in example). Those who have never thought of it will quickly see the saving in time. After a few multiplications, one can tell at a glance just what digit to use for quotient:

EXAMPLE.

$\pi = 3.14159+$) 24.00000 | 7.63944+

21 99113

2008870

1884954

1239160

942477

2966830

2827431 = 101 figures

1393990

1256636

1373540

1256636

1.16904 Rem.

Circumf. $1 \div \pi$ = const. 0.31831

24

127324

63662 = 25 figures.

7.63944

GEO. B. FOOTE.

[We heartily agree with all that our correspondent says regarding the use of logarithms, and have in preparation a short series of articles on the subject which we trust will meet his views.

His constant for finding the diameter of a circle when the circumference is given, takes advantage of the fact that multiplication usually involves fewer figures than division. It is probable, of course, that this constant has been used before as it seems obvious enough after being once suggested, but nevertheless, we are not aware of its use having been suggested in print. On this account we have called it Foote's constant for diameters.—Ed.]

An American Machine-Tool Store in Paris.

M. Francis Fenwick, of Fenwick, Fréres & Co., 21 rue Martel, Paris, which firm has for some years acted as the representative in France of the Brown & Sharpe Mfg. Co., and of the Pratt & Whitney Co., is here at present with the engineer of the company, M. Francoia Mandon, for the purpose of more fully investigating American machine tools, especially those adapted to bicycle manufacturing.

On January 1st the company opened a store at the address given above, in which they will hereafter carry a stock of American machine tools. It is the opinion of these gentlemen, based on considerable study and experience in the matter, that Americans are superior in the lines of work indicated, and that eventually French manufacturers must adopt American systems of manufacture; and that in order to do so, they must obtain from this country at least the number of machine tools required to commence the work with the degree of accuracy required, as no such machinery is produced in their own country.

M. Mandon stated, during his visit to this office, that he had taken pleasure in helping to extend the circulation of the "American Machinist" in France, and that it was highly appreciated among such engineers there as had become acquainted with it. And a curious circumstance is that in some cases the paper seems highly appreciated, and is spoken of in very high terms by engineers who do not read English, but who derive their ideas of what is in the paper entirely from its illustrations. M. Mandon remarked in this conection that he did not know what they might think of the paper could they read its text.

Both the gentlemen named seem better acquainted with American machine shops than some Americans are, and American machine-tool builders have in them valuable and appreciative friends.

For the past eleven years the "Journal of the Association of Engineering Societies" has made a feature of an index to current engineering literature. This index has appeared in monthly instalments, the instalments being republished at the end of each year in an annual summary. These annual summaries, for several years together, have also been republished in a bound volume. The December number of the "Journal," containing the annual summary for 1895, is before us, and we note that the index is discontinued with this number. This action is taken in consequence of the publication of a similar index by the "Engineering Magazine," which we are glad to note is also to continue the annual summary feature. The "Engineering Magazine" has also agreed to republish in a bound volume those annual summaries of the "Journal" which have not been so published. The engineering world has thus at its command an index extending over the past eleven years, together with the assurance that it will be continued on substantially the same lines in the future.

While we have always looked upon this index as a most praiseworthy enterprise, we are bound to express a hope that our own appearance in it is not a sample of its accuracy. We still appear as published at 96 Fulton street—price two dollars a year, or ten cents a copy—and this in spite of notification by us of the error. The address has not been right for four years, and the price has never been right.

It quite often occurs that readers who reside in large cities write and ask questions which we cannot answer without further information regarding the conditions, and our letters asking for such information are usually returned to us undelivered because we cannot give the street and number. This will explain why many of our readers, as we suppose, think we ignore their communications.

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"Relative Rank" In the Navy.

In our issue of the 6th inst. we quoted "Engineering," of London, as saying: "We think that an engineer who is anxious to change the name of his rank to that of an executive officer, pays his branch of the profession a very poor compliment." This, on the face of things, seems true enough; but, as we said at the time, the engineers of the United States Navy who are fighting for a chance to live are, naturally, not likely to concern themselves overmuch with questions of compliments.

We have looked into this matter somewhat, and find that there are many excellent reasons why the United States naval engineers should be given positive rank, as the Squires Bill provides, instead of relative rank, which they now have.

The fact is that officers of the line have always taken advantage of the matter of "relative rank," and by means of it have, in many cases, continued to deprive engineer officers of their plain rights—even of some rights plainly intended to be given them by the law.

The fact is that, by any reasonable view of the matter, the engineers of the modern naval vessels are entitled to military rank—if they want it. Our engineer officers would not want it if it had not been borne in upon them by years of bitter experience that they must have it if they are ever to secure the position in the navy that is of right theirs. In acquiring such military titles, they are not, we are quite certain, intending to lessen the real distinction between themselves and line officers; for they are proud of their profession, as they ought to be, and want military titles only for purposes of self-defense, and not for parade.

The title "Lieutenant of Engineers, United States Navy" for instance, is intelligible and has a definite meaning; but, more than this, an engineer holding that title would not be compelled to put up with quarters on shipboard inferior to those assigned to a Junior Lieutenant of the Line, as is now the case; and a good many invidious distinctions now made by "the line," both officially and socially, would be rendered impossible, as they should be and must be if the dignity and usefulness of the Engineer Corps are to be maintained.

In all arguments before Congress, and when any legislation comes up that the line wish to oppose, they always claim that the word "relative," as applied to the rank of the Engineer Corps, really has no meaning, and that all rank is relative, and consequently that engineers now have all that is necessary. It is really true that the word "relative" should give engineers the corresponding rank; but the commanding officers of ships and the Navy Department also have construed it to mean that staff officers have no actual rank, and they are treated accordingly. It will ever be so until the rank is expressed by the title and distinctly given by law.

Some of the most eminent lawyers have declared that the word "relative" should not be construed as the department construes it; but that has made no difference, and the construction of the department has now become law by long custom.

The Chief Engineer of a ship does not have full charge of his men; they are not under his command; but he is merely "in charge of the department." This is well illustrated by the recent case of a Chief Engineer who, on his promotion to the relative rank of Commander, desired a new commission to be made out, and appealed to the Attorney-General of the United States. The latter decided that law intended him to have a new commission; but that the custom of the department had been to only write a letter telling him that he had reached the relative rank of Commander, and that this custom had been so long in use that it was now a law, and he could not get his commission.

It is so with the construction of the word "relative," and it is vitally important that the law should be so worded that no such construction could be put upon the position except that intended by the law; and, after many years of contention with "the line" and of thought on the subject, the engineers find that it is positively necessary to have the title to avoid such distinctions.

A case is known where a Chief Engineer made complaint against a Junior Officer of the Line as his inferior officer, and the Captain of the ship refused to recognize him as such, remarking to the engineer in a sneering way: "Yes; I believe you have a certain relative rank, but I do not see how that affects the situation."

It seems almost incredible that a mere custom of the Navy Department should be declared by the Attorney-General of the United States to have more force than a plain law of Congress, but such seems to be the case; and it would seem to be nearly time that Congress should take a hand in this matter, and endeavor to see whether it can pass a law that will prevail over "customs of the department," and the selfish influence of "the line" in its effort to dominate everything pertaining to naval matters, and to retain usages and customs which advances in naval construction and in engineering science, and the necessary changes in handling naval vessels that have been brought about thereby, have rendered absurd, and which constitute a serious obstacle to naval efficiency.

It is ridiculous for Congress to go on appropriating millions of dollars for the construction of new naval vessels, and at the same time allow the purposes for which these vessels are built to be largely

defeated by the selfish and obstructionist tactics of "the line," and by the apparent subjection of one Secretary of the Navy after another to "line" influence solely.

Keys and Set Screws.

Mr. Crane's article about fastening fly-wheels is a fine collection of terrible examples, and as such is not without value. It does service also to the mechanical world in helping to reveal to one half of it how the other half of it is in the habit of doing things. The device of pening the arms of a fly-wheel to make it run true, and of doing it over and over again, will, we doubt not, be a revelation to the mechanical four hundred.

It is not everyone who always remembers that the function of the fly-wheel necessarily implies that at times it is driven and at times it is the driver, and that the relative torsion of shaft and wheel hub is continually being reversed; and that, so far as the key is subjected to any driving strain, that strain may at any one instant be upon one side of it, and at another instant upon the other side of it.

The function of the key itself is quite generally misunderstood among mechanics. The practice of the average mechanic has been continually at variance with his theory as to the way in which a key usually operates to do its driving. We have gone on fitting our keys with parallel sides and a loose side fit, and with a good taper and a good bearing, and a tight as possible fit on the top and bottom of it, when driven home; and yet many of us have all the while continued to carry in our heads the idea that the sides of the key do the driving.

Even Mr. Crane carries the same idea in his letter. His idea is that any driving wheel or any driven wheel, so that it has only the one function, will work all right because it will, under the torsion, fetch up against one side of the key, and that will be the last of it, while a fly-wheel will, under the alternating torsion, be continually crowding, first against one side of the key and then against the other, and so work itself loose. The fact is that a wheel on a round shaft should hold by friction alone, and the key is only the means of applying the necessary friction. Even in the old way of "staking" wheels upon an octagonal shaft, by means of keys all around it, there was usually no side fit at all to the keys. The shaft should fit the hole as tightly and perfectly as possible, and then the key, by slightly elongating the hole at one point, makes all the rest of the hole hug the tighter. A single key should be sufficient, and should be better than more keys for any wheel if it perfectly fit the shaft.

The necessity which exists for making large wheels in halves and clamping them upon the shaft is not to be regarded as a misfortune, as that makes it certain that the wheel will hug the shaft and leaves almost nothing for the key to do, except to gently hint to the wheel and shaft where they belong in relation to each other. In punches and shears made by Wm. Sellers & Co. the friction hold of the wheel upon the shaft seems to be completely recognized, in the fact that a solid fly-wheel is cast with the hub divided by radial cores into three parts, and then made to hug the shaft by bolts through each partition. By this means the absolute contact of the entire hole with the shaft is assured, and no one can doubt that the wheel will be held securely in its place, and do its driving work without any part of it getting loose.

The turret lathe and the screw machine have not been entirely benefactors, in that they have promoted the use of set screws in places where it would have been better to have made it impossible to use them. Set screws in pulley hubs for light driving are not to be hastily condemned, because they are cheap and handy and sufficient for their duties; but the misfortune is that the use of set screws in such places sets the cheap builders to thinking of the possibility of using them upon engine shafts and similar places, and makes it possible and proper and necessary for Mr. Crane to write such an article as he has given us.

Where set screws are to be used, and used successfully, for holding pulleys, or for light work, their best success will be found in the same conditions which make the key so successful in its place. The fit should be as good as possible. Rolled shafting may be produced with wonderful accuracy; but accuracy in rolled shafting is an expensive thing to the producer, just as any other accuracy is expensive; yet it is a very necessary detail if the user is to use it with the best success.

It is within our knowledge that purchasers of shafting, buying directly from the makers, and who have established some reputation as "kickers," have been able to obtain shafting closer to nominal size than some other purchasers who have been less exacting; and there is, therefore, probably no more appropriate place for vigorous kicking than where shafting is off size. Then the reamers for the pulleys must, of course, also be kept to some fixed limit of accuracy, by kicking if necessary; and with these two points insisted upon, there is a large—a sufficiently large—field for the use of set screws. For a hub to be held by set screws, it should be as light as it is possible to use it without danger of breaking; so that when the screw is tightened, the hub will spring and hug the shaft; and for this service a round-pointed screw will be better than any other. If a sharp, conical-pointed screw is used, or a cup-pointed screw, then it is assumed that the screw is to do the driving; and we have mutilated shafts, and after a little while we have ruined shafts, and often, also, pulleys that must be broken to get them off, or which are broken in attempts to get them back to their right places. For places and conditions where set screws should not be employed, Mr. Crane's letter seems to give the necessary suggestions.

Many of our readers have no doubt often asked themselves why the armature should be the most perishable part of electrical machinery, while the field coils carrying the same curent give practically no trouble.

Mr. Baxter's article, which we print this week, will be found to give a very clear explanation of this well-known fact. Having explained the causes of armature deterioration and burn-outs, Mr. Baxter's next article will contain an equally clear discussion of the merits of different forms of armature construction, and the precautions necessary to secure the greatest practicable degree of durability.

Questions and Answers.

Name and address of writer must accompany every question.

Questions must pertain to our specialties and must be of general interest.

We cannot undertake to answer questions by mail.

(41) J. M. M., Butler, Pa., asks: Is there no method by which brazing can be done without heating? A.—We know of no such method.

(42) J. F., asks: Why is a small gear called a "pinion"? A.—We do not know. The etymology given in the dictionaries seems to have nothing to do with the case. It is suggested that the term comes from the fact that originally the teeth of pinions were made of rods or pins, and the large gear may have been called the "tooth wheel," and the small wheel the "pin one," or "pinion."

(43) E. A. S., Worcester, Mass., writes: I would like to know whether, after a piece of steel has been hardened and the temper drawn to a straw color, which would be about 430 degrees Fahr., then cooled off and reheated to the same degree a number of times, would the steel be softer by the subsequent reheating? A.—We think it would not become materially softer unless the reheating were performed a number of times, and possibly not then. It is probable that nothing but a test would determine this point.

(44) F. W. Y., Chicago, says: Steam passing through a short length of pipe freely into the atmosphere, from a boiler in which the pressure is maintained at one hundred pounds, has a speed due to that pressure. What is the pressure per square inch exerted upon the wall of the pipe? A.—At the entrance to the pipe the pressure would be equal to that in the boiler, less that due to the entry and velocity heads; at the discharge end the pressure would be that due to the velocity head at that point; at intermediate points

the pressure would gradually reduce from one to the other. To attempt to reduce this statement to figures would lead to a very complicated expression, as the pressure would decrease and the velocity increase as the discharge end was approached. The first result would diminish and the second would increase the friction against the pipe. All of these factors would enter into the determination of the final velocity of discharge, which, again, would determine the velocity of entrance. We should expect an indeterminate equation as the result, which could only be solved by approximation. The condition of the steam as regards dryness would also enter into the coefficient of friction, and this dryness would vary with the varying pressure along the pipe. We are not aware of any solution of the problem, nor of any sufficient experiments on the coefficient of friction to enable it to be solved, but the above statement will indicate its complexity.

(45) H. P., St. John, N. B., asks: Is the rule to reckon the horse-power of belting, each inch in width running 800 feet per minute for one horse-power, a correct one under the following conditions: A 14-inch belt from a 72-inch pulley on engine drives, with other machinery, a pulverizer which is driven through countershafting by a 6-inch belt, the driving pulley being 40 inches in diameter and 540 revolutions per minute, and the pulley on pulverizer 7½ inches diameter, giving 2,880 revolutions per minute. A.—The rule quoted above is handy and sufficiently liberal, and is, of course, applicable to such cases as this, but unfortunately our correspondent does not give sufficient data. We have from the particulars given absolutely no means of knowing the speed of the 14-inch belt. The 6-inch belt we can, however, apply the rule to: 3½ feet, the diameter of the driving pulley, multiplied by 3.14, to get the circumference, and this by 6 inches, the width of belt, and then by 540 the number of revolutions, and all divided by 800 gives us 42.39 horse-power,

$$\frac{3\frac{1}{2} \times 3.14 \times 6 \times 540}{800} = 42.39 \text{ horse-power.}$$

This, of course, tells us nothing about the power actually tranmitted, but only that a 6-inch belt with the above pulleys and speed would easily transmit this amount of power, or that having this amount of power to transmit at this speed the 6-inch belt would be suitable for the work. Many use 600 feet of 1-inch belt, or 50 square feet, as the basis of computation, instead of 800 feet, or 66⅔ square feet. 2. Can you give me a rule for the maximum diameter of journals in proportion to the number of revolutions per minute to run in babbitted bearings without heating? For instance, what is the highest speed a journal 1½ inches diameter could be run? A.—Journals may be run at a surface speed of 1,200 feet per minute, or considerably higher than that if lightly loaded. With a pressure of 100 pounds per square inch of bearing a 1½-inch shaft may be run at 3,000 revolutions. The journal should fit the bearing rather loosely.

(46) I. H. R., Georgetown, Conn., sends us the above sketch and asks: Which of the two shapes would be the proper one for a concave key for a bevel gear, one shaft 1¼ inches, and the driving shaft $1\frac{1}{8}$? Which will slip first, both being driven alike, and should they be case hardened? A.—In this case the concave side of one key is assumed to fit the shaft, while the other key is made more concave, so that the sharp angles will bed themselves into the shaft. We have used both forms of key, but never depended upon driving the latter style very much if at all. We have always seen it used in connection with set screws coming down upon it to make it bite the shaft. This key should be made of tool steel and should be slightly hardened; a spring temper got by blazing it off in oil would probably do very well, but we never liked this style of key at all. A key with the concave fitting the shaft, and nicely fitted all over, and well greased before driving should hold the gear very well if it was a good driving fit on the shaft. Case hardening would do the key no good, although it should be of steel, and as hard as it could be conveniently worked.

(47) Wm. L., of Davenport, Iowa. writes for a solution by logarithms of the following problem:

$$\frac{\sqrt[5]{.00743}}{\sqrt[.6]{.006}} = ?$$

Our correspondent gives his procedure which seems to be correct, but as he does not give his figures in full we are unable to check his work. Our solution is as follows:

log. .00743 = $\bar{3}.870989$ =	$\bar{5} + 2.870989$
divide by 5 giving	$\bar{1} + .574198$
or	$\bar{1}.574198$
log. .006 = $3\ 778151$ =	$\bar{6} + 3.778151$
divide by .6 giving	$\bar{10} + 6.296918$
or	4.296918
from	$\bar{1}.574198$
take	$\bar{4}.296918$
giving	$\bar{3}.277280$

which is the logarithm of 1793.5.

The determination for the denominator may be checked, as it happens, by taking advantage of the fact that $.6 = \frac{3}{5}$ so that

$$\sqrt[.6]{.006} = \sqrt[\frac{3}{5}]{.006} = (.006)^{\frac{5}{3}}$$

Now, proceeding again

log .006 =	$\bar{3}.778151$
divide by 3 giving	$\bar{1}.2593837$
multiply by 5 giving	6.296918

which is the same as was found by the first method.

(48) J. N., Cohoes, N. Y., asks several questions: 1. What is the tensile strength of a piston rod 10 inches in diameter? A.—Piston rods are made of various materials, and the tensile strength depends upon the material. As the area of the rod is 78.54 square inches, if the material, say wrought iron, has a tensile strength of 30,000 pounds per square inch, then the tensile strength of the rod will be $78.54 \times 30{,}000 = 235{,}620{,}000$ pounds; so, if the tensile strength of the material is 70,000, which is common enough in steel, the tensile strength of the rod is 549,780,000 pounds. In determining the size of a piston rod for a given service, of course, a large factor of safety is used, depending upon the length of stroke, piston speed and other particulars. 2. What is meant by the pitch of the screw of a steamer, and how is the speed calculated from the number of revolutions? A.—The pitch of a screw propeller is understood in the same way as the pitch of any other screw. It is the distance which any point in a blade will travel in the direction of the axis during one revolution, assuming that there is no slip. Multiplying the number of revolutions (N) per minute by 88, and dividing the product by the pitch of the screw in feet (P), will give us the speed in miles per hour (V) without slip: $\frac{88\,N}{P} = V$. The slip may vary from 10 per cent. up to 50 or more, depending upon the ratio of screw area to the submerged section of vessel, and various matters that we have not space to go into. 3. What is saturation, and what is it on the salinometer scale? A.—The saturation point is reached when the liquid contains all the salt that it can hold in solution. The graduation upon the salinometers for marine use do not extend to the saturation point. Sea water contains by weight 3.39 parts of salts in solution in 100. It is saturated when it contains 36.37 parts to the 100. 4. What is the degree of saltness or saturation in a marine boiler? A.—This question must refer to the permissible saltness in marine boilers, as it must, of course, never approach the actual saturation point. The salinometer registers 0° for pure water and 10° for sea water; and with jet condensers, and feeding only sea water, the water in the boilers should not be allowed to go beyond 30°. The amount of salt deposited on the surface of the boiler does not depend on the density of the water, but only on the quantity of sea water pumped into the boiler. It is said that the boiler of a surface condensing engine may be worked with perfect safety and with economy when the water is four times as salt as sea water, or when the naval hydrometer registers 40°. The Boiler Committee of the British Admiralty appointed in 1873 recommended that the boilers of surface condensing engines be worked at 45°, and those of jet condensing engines at 35°. 5. I have a formula for working the safe pressure of a boiler, but can't understand where the 2 comes in:

$$\frac{T \times t \times 2 \times .56}{D \times 6} = W\,P$$

This is for single-riveted seams; and for double-riveted seams, 20 per cent. is to be added to the result. T is the tensile strength of the plate per square inch of section; t is the thickness; D diameter in inches; 6, the factor of safety; and .56, the ratio of strength for the single-riveted seam. A.—As the shell of the boiler has two opposite sides to resist the stress, the 2 is inserted in the formula in recognition of that fact.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Adding Machine. Grant; see page 36.

Power Hammers. Beaudry & Co., Boston.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, write Walter Donaldson & Co., Wash, D.C.

Model making and electrical experimental work. F. W. Gardam & Co., 58 Ann st., N. Y.

Engine castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Aluminum and Brass Castings, Machinery, Name Plates. Twining Campbell, Paterson, N. J.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Marine Iron Works, Chicago, builders of steam yachts and marine machinery; catalogs free.

Mannocitin permanently prevents rust. Testimonials explain. O. Goetze, 14 Whitehall st., N. Y.

Just issued—Catalog No. 8. Mailed Free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Key Seaters for any length of hub or width of keyway. New, handy machines. Mitts & Merrill. 913 Tilden street, Saginaw, Mich.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, Tolland, Conn.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

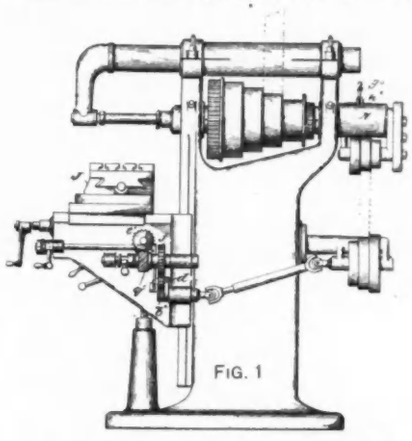


FIG. 1

IMPROVED MILLING MACHINE.

Some Recent Inventions in Metal-Working Machines and Tools.

Figs. 1, 2, 3 and 4 illustrate a construction recently patented to Mr. Frederick Holz, of Cincinnati, which has for its object the automatic feed and release of milling-machine tables in any direction, as well as the firm support of the outer end of the cutter spindle. The figures show respectively a side view of the machine, a vertical section of the knee, a plan

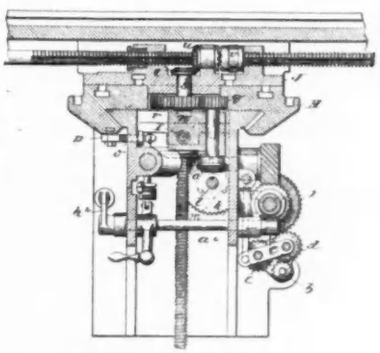


FIG. 2.

TABLE FEED MECHANISM.

of the same with the table turret removed, and a section of the out bearing for the spindle.

The trains of mechanism for accomplishing the different feeds will be separately considered. The telescopic driving shaft, through the reversing gears *b*, *c*, *d*, give the usual table feed, through the train *j*, *k*, *m*, *o*, *q*, *r*, *t*, *u*, to the nut *v* on the feed screw. It will be noted that the table *J*

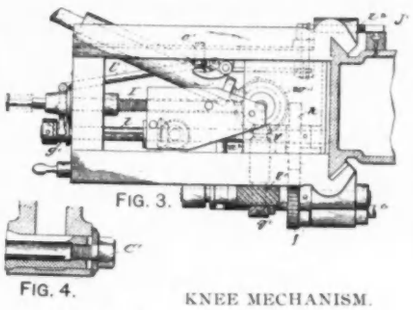


FIG. 3.

FIG. 4.

KNEE MECHANISM.

OUT BOARD BEARING.

revolves about *s* to give angular feeds, and has the usual adjustable trip for throwing out the feed.

The other horizontal feed, parallel to the spindle axis, is accomplished through shaft *l* and screw *I* (Fig. 3), and their connecting gearing housed in the knee frame. The automatic stop for this feed is seen at g^1, l^1, o^1, p^1.

The vertical feed of the knee is through the train q^1, t^1, v^1, w^1 and its automatic release by means of J^2, adjustable on the main column i^2, h^2 and a^2, as will be understood. Separate hand feeds and stop levers are also provided for each motion.

The out bearing of the cutter spindle, shown in Fig. 4, has a three-part sleeve which, when drawn by the screw C^1,

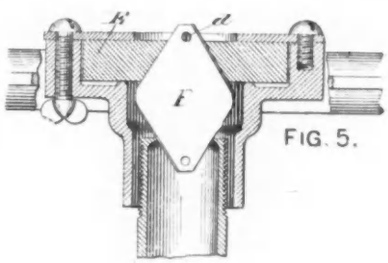


FIG. 5.

A PIPE REAMER.

centers and clamps the spindle to any desired working fit.

At *N* (Fig. 1), inclosed back gearing, shifted by the lever g^3, gives change of speed to all the drivers without stopping the machine.

Fig. 5 illustrates a driver capable of being fitted to an ordinary die stock for reaming the interior burr left by the pipe cutter. *E*, corresponding in size and shape to the threading die, holds a reversible reaming blade *F*, secured in place by the pin *d*. This reamer is the invention of Mr. O. B. Hall, of Malden, Mass.

We are glad to note the establishment in Pawtucket, R. I., of a successful Evening Drawing School. It was founded by Mr. G. C. Anthony, now of Tufts College, and is now conducted by Mr. Wm. A. Newell. The attendance is 78. Talks on mechanical power are also delivered.

More Cheap Oil for Sale.

In our issue of January 30th, we published some fac-simile reproductions of letters from swindling operators in oil, located in Cleveland, O. Since publishing that free advertisement, we have heard of other "companies" in Cleveland that are making similar propositions. Here is one of them:

Cleveland, O., January 22, 1896.
Graham Foundry & Machine Co.,
Monongahela City, Pa.:

Gentlemen—Some time ago we shipped a barrel of No. 1 lard oil to a party in your vicinity, and upon learning that he was not responsible we stopped delivery of the goods. We desire to dispose of the oil, and if you will accomodate us by taking the same we will make the price 32 cents per gallon, less freight and no charge for package. This is a strictly first-class oil, and we guarantee these goods to give perfect satisfaction in every respect.

Kindly let us hear from you, and oblige,

Yours very truly,
PROSPECT OIL CO.,
Per A. W. Knight.

It is needless to say that the Graham Foundry & Machine Co., did not order the oil; instead they sent the letter to us.

The Rand Drill Company, North Tarrytown, N. Y., write us under date of February 1st as follows:

American Machinist,
256 Broadway, New York:

Gentlemen—In the issue of the "American Machinist" of January 30th, we notice your article entitled, "An Oil Swindle Exposed," and being among those who have taken the bait once, but refused it the second time, we inclose a copy of our letter of November 18, 1895, to the Leader Oil Co., which may interest you.

Yours truly,
RAND DRILL CO.,
H. V. Conrad.

The copy of the letter referred to is as follows:

November 18, 1895.
The Leader Oil Co.,
Cleveland, O.:

Gentlemen—Replying to your favor of November 16th, we cannot use the oil you speak of, and trust you will not undertake to send it to us, as we will not receive it. We had a similar proposition from a Cleveland Oil Company some time ago, and consented to take the oil and found it good for nothing.

Yours truly,
RAND DRILL CO.,
(Signed) H. V. Conrad.

We thus have the Valley Lard Oil Co., the Superior Oil Co., the Prospect Oil Co., and the Leader Oil Co., all of Cleveland, O.; and all of whom are liable to have small lots of oil at various

places which they will dispose of very much below value rather than pay return charges. We published a chemist's analysis of the Valley Lard Oil Co.'s "Ex. No. 1 Lard Oil," showing it to be only 27.75 per cent. lard oil—the rest mineral oil. We wonder how many men it requires to operate these four companies in Cleveland?

A Novel Planimeter.

In any of the familiar forms of the planimeter great difficulty is experienced in reading the instrument on account of the fineness of the lines and the lack of contrast of surface. In the planimeter shown herewith the shaft upon which the wheel turns is a transparent glass tube, and inside the tube is placed a scale printed upon specially prepared paper, giving the most perfect legibility, and as the ends of the tube are hermetically sealed the durability of the scale is assured. By the use of this planimeter, also, the mean effective pressure of the diagram is read from the instrument without any supplementary computation.

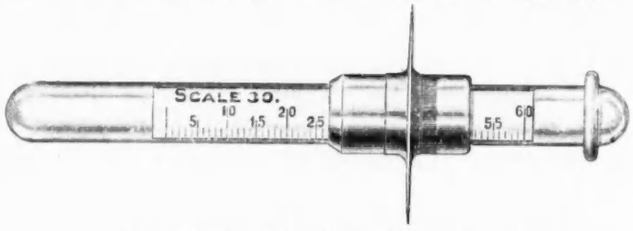


Fig. 2. GLASS TUBE AND SCALE, FULL SIZE.

Fig. 1 shows the complete planimeter in use, and Fig. 2 shows the glass tube and traveling wheel, full size. The left hand end of the tube is secured in a socket of the instrument. Each tube contains two different scales upon opposite sides, and three tubes, or six scales, are supplied with each instrument, while additional scales are, of course, easily procurable.

The wheel is made with a knife edge and the reading is the distance traveled by it upon the glass tube or shaft. The wheel has no side movement upon the paper, and no inducement to slip, so that its accuracy is not influenced by the surface upon which it moves, and as the resistance felt in tracing is constant it is much easier to follow the lines.

When the instrument is adjusted to the length of the diagram to be traced the reading will be the mean effective pressure, absolutely without computation. For any length or kind of diagram, if a forty scale is used, and the points are set four inches apart, or with a sixty scale and the points six inches apart, the instrument reads in square inches and tenths. The points here referred to are the tracing point and a spring actuated point at the center of the pivot.

Fig. 3 shows the method of making this simple adjustment. The set screw *S* is loosened, and then upon pressing the small knob a steel pin is protruded down through the center of the pivot screw, and the long bar with the tracing point is slid out or in until the distance between these points is the same as the length of the diagram, when the screw *S* is tightened and the instrument is ready for tracing.

This planimeter is the invention of Mr. A. C. Lippincott, and therefore bears his name. It is manufactured by the Hine & Robertson Co., 68 Cortlandt street, New York City.

Freight Charges on Machinery Shipped to France.

During a recent call at this office by M. Fenwick, of Paris, referred to elsewhere in this issue, the present burdensome charges exacted by the French transatlantic steamship line were referred to, M. Fenwick stating that the charges on machinery from New York to Havre were about $10 per ton, plus 5 per cent., and that in every instance where a single case or package weighs over 30,000 pounds, a charge of at least $25, and perhaps more, is exacted for the use of a derrick to unload the package from the ship.

Machinery shipped by the German steamers is charged for at the rate of only $4 per ton to Hamburg, and the charge to Antwerp is only $6 per ton; but the French customs law requires that a special extra import duty be paid on shipments which have been previously delivered at any foreign port and then reshipped to France. This extra charge is made for the protection of the French line, and in order to compel French importers to use that line; and there being no effective competition, the French line naturally charges up to the limit of its protection, which it is plain to see in this case operates very decidedly against American trade with France—in other things, we suppose, as well as in machinery. Perhaps if American machinery trade with France is to be developed, it might be well for some effort to be made to correct this abuse.

"Explosions" of Gasoline.

A recent so-called "explosion of gasoline" in a Pullman car standing upon the tracks at Pittsburgh, reminds us that there is probably no one thing about which there is more of popular error than this matter of the explosion of gasoline. The incident referred to illustrates this ignorance. The carpets, plush trimmings, etc., of the car were being cleaned with gasoline, when suddenly there was a terrific explosion which wrecked the car, injured three other cars standing near by, and rendered the persons working in the car unconscious. The press dispatch goes on to say that the manner in which the gasoline became ignited is not explained, and that the cause of the explosion is a mystery. Now, the fact is that gasoline did not explode, and that gasoline will not explode. The cleaning that was being done in this car simply gave opportunity for the rapid evaporation of a considerable quantity of gasoline. This vapor, mixed with the air contained in the car, formed an explosive mixture of gas; and this gas coming into contact with a flame, such as a lighted match, became ignited and exploded, as such a mixture of gasoline vapor and air always will do. Had the windows and doors of this car been open, so that the vapor would have had a chance to get out of the car as it formed, there would probably have been no explosion. But it should be remembered by all who have to do with gasoline, turpentine, or any volatile oils, that when these oils are allowed to vaporize, in a confined space, and the mixture of air and vapor thus formed becomes ignited, there will be an explosion.

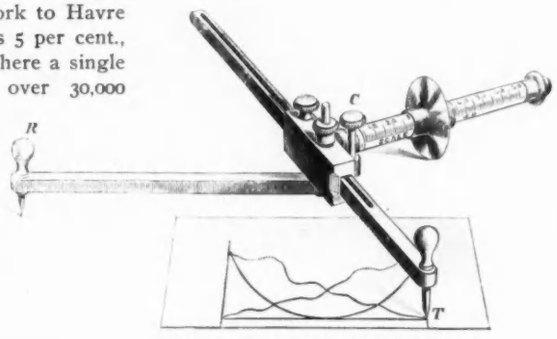


Fig. 1. A NOVEL PLANIMETER.

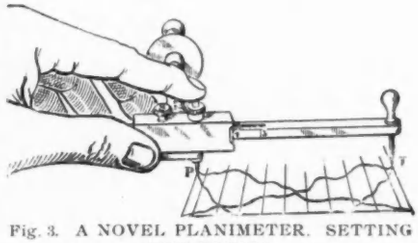


Fig. 3. A NOVEL PLANIMETER. SETTING THE POINTS.

A similar explosion, with serious results, took place near New York a few days ago, where a young boy was sent into a tank to paint its interior with a paint containing a considerable proportion of turpentine. As the tank was dark, he was obliged to work with a lamp, and when the air in the tank became sufficiently impregnated with the vapor of turpentine there was an explosion which seriously burnt the boy.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Mach. f'man, 12 y'rs exp. wants pos. J. R. AM. MACH.

Mech. draftsman wants pos. Box 36, AM. MACH.

Sit. wanted, hyd. and spec. mch. designer; tech. educa.; can take charge room. Box 12, AM. MACH.

Mechanical draftsman wants position. 10 years' exp. in gen. machinery and engine work. Address D. B., care AMERICAN MACHINIST.

A practical machinist, American, with some experience on the road, wants a position as traveling man. Box 38, AMERICAN MACHINIST.

Situation wanted by exp. mechanical draftsman. Machine tools. General machinery. Shop exp. Address C. D., care AMERICAN MACHINIST.

Wanted—A good machine tool man as the contractor for the output of entire plant. A good opening for the right man. Box 15, AM. MACH.

Draftsman's asst. desires position in N. Y., has had 7 years' shop and 1 year drawing-room exp. on machine tool work. Box 46, AMERICAN MACH.

Wanted—Position by experienced American mechanic capable of running shop; also skilled in erecting steam and electric mach'y. Box 45 AM. MACH.

Mechanical engineer and draftsman open for engagement; labor-saving machinery, jigs and fixtures a specialty. Box 47, AMERICAN MACHINIST.

Wanted—Three first-class outside working bosses on tanks and stand pipes. State exp., last place of emp. and wages wanted. Add. V. D., AM. MACH.

Wanted—Comp'nt draftsman, preferably with exp. in constructing machines for light sheet metal, presses, dies, etc. Address 0-354, care AM. MACH.

Wanted—A first-class layer-out for general boiler work. State exp., last place of employment and wages wanted. Address V. D., care AM. MACHINIST.

Wanted—A good draftsman experienced in engine work. Apply by letter, giving salary required, and references. The Ball & Wood Co., 15 Cortlandt St.

Wanted—An energetic and experienced man to take charge of 100 screw machines on first-class work. State age, experience and salary expected. Box 29, AMERICAN MACHINIST.

A party with a number of years' exp. in manuf'g business desires a sit. Has had good success in management of help. Best of ref. given. Address Twenty-Three, P. O. Box 2003, Boston, Mass.

Wanted - Man of exp. to take charge of tool room in brass-wkg estab. Must be thoroughly familiar with mod. tools and methods; a hustler. No experimenter need apply. Box 30, AMER. MACHINIST.

Wanted Dftsman—For the purpose of compiling & tabulating data in an eng. & boiler works. Accuracy on weights and dimensions; no designing. State experience and wages. V. D., care AM. MACH.

Wanted—A young, experienced and energetic man as foreman of a department making high grade interchangeable machinery. State age, wages expected and full particulars. Box 50, AM. MACH.

Employment wanted by a man of 30 years' experience as machinist, designer and manufacturer in the best shops of New England. Can give the best of references. Address, Box 43, AMERICAN MACHINIST.

Position wanted as superintendent or draftsman; experienced on Corliss and high-speed engines, refrigerating and water-works machinery and special tools; good manager and designer. Alonzo G. Collins, 318 Avenue D, San Antonio, Tex.

Wanted—Position as brass foundry foreman, thoroughly exp. in mould'g and cast'g all kinds of heavy and light work, also mixing and melting all kinds of brasses and bronzes in air, reverbratory gas furn. & cupola. Geo. Pyne, 4315 Beach Hill Ave., Cin., O.

Engineer and machinist, age 38, exp. on boilers (Scotch, hor., tubular, etc.), engines and general mach. Entire charge of works or estimating and engineering depts. Capable manager and salesman. 15 yrs. in charge. H. K., care AMERICAN MACHINIST.

MISCELLANEOUS WANTS.

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header made by C. H. Baush & Sons, Holyoke, Mass.

For Sale—A first-class key-seater, new. Address Mitts & Merrill, 913 Tilden st., Saginaw, Mich.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

A job lot of 200 000 set and cap screws and bolt forgings, in lots to suit. Send for list and prices. F. W. Beals & Co, Lynn, Mass.

6-inch, 8-inch and 10-inch screw cutting lathes, milling and gear cutting attachments. Wallace H. Mansfield, New Haven, Conn.

For Sale—Vols. 4 & 5, 6 & 7, 8 & 9, 10 & 11, bound in 4 vols. 12 bound single. Vols. 13, 14, 15, 16, 17, 18 unbound but complete. Price, $40.00. W. H. Ermentrout, Reading, Pa.

Just Published. *Two Reliable Books.*

"SHOP KINKS,"

By ROBERT GRIMSHAW.

Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.

400 Pages, 225 Illustrations, $2.50.

"It is full of valuable and helpful suggestions, regarding things that can be applied to shop practice."—AMERICAN MACHINIST.

The Modern Machinist,

By JOHN T. USHER, Machinist.

Specially Adapted to the Use of Machinists, Apprentices, Designers, Engineers and Constructors.

A practical treatise embracing the most approved methods of modern machine-shop practice.

A New Book from Cover to Cover. 320 Pages. 257 Ills., $2.50.

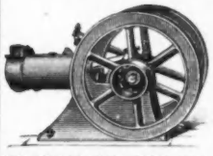
There is nothing experimental or visionary about this book, all devices being in actual use and giving good results. It will be found a valuable addition to any library, and be consulted whenever a new or difficult job is to be done.—MACHINERY.

☞ *Illustrated circulars of both sent free.*

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

NORMAN W. HENLEY & CO., Publishers,

15 Beekman Street, NEW YORK.

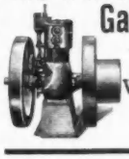


WANT POWER?

The PIERCE Gas and Gasoline Engine is the best and most economical. Address,

PIERCE ENGINE CO., 19 Racine Street, Racine, Wis.

The Wolverine Stationary Gas and Gasoline Motors.



Write for Descriptive Pamphlet.

WOLVERINE MOTOR WORKS,

12 Huron Street,

Grand Rapids, Mich., U. S. A.

ONEIDA MFG. CHUCK CO.,

40 to 44 Cedar Street, Oneida, N. Y.

DRILL AND LATHE CHUCKS.

"CZAR DRILL CHUCKS"

Exclude dirt and chips from working parts. All steel, hardened. Powerful grip. Holds and drives drills true. Adapted for hard service. Send for our Catalogue A.

WANTED! **Machinists of general experience, for light work, within 75 miles of New York City. Address, stating experience, amount of wages expected, etc., Box 51, care American Machinist.**

COMMERCIAL REVIEW.

NEW YORK, SATURDAY EVENING, FEB. 22.

Machinists' Supplies.

That the present month, as compared with last, shows a falling off in the way in which most of the goods classed under the above heading are moving to consumers, is a proposition sustained by an overwhelming weight of authority in this market. January's trade is pronounced by some to have been very encouraging, and to account for the present period of dulness a great variety of hypotheses are offered. There is, firstly, the old stand-by, public financial difficulties, without some reference to which no article on the commercial situation would seem complete. We are told by one seller that, when trade began to fall off, he attributed it to the bond question, but that the continuance of the depression tended to preclude that idea. Assuming that, as some say, and as may be more true in some lines of supplies than in others, a lull in midwinter previous to the opening of spring trade, is the natural thing to expect, the season of the year may be held responsible for the present quietness. But others looked for a relatively brisk business in February and it has been suggested, through not very confidently, that the orders may have come earlier than usual. Again, it is said that some concerns take inventory about February 1st, and we may be feeling the effects of this. The character of the month itself may not have been without influence upon the situation since it is a short one, broken in upon by holidays and characterized by weather that tends to congeal the market.

The activity in bicycle manufacture is helpful to the trade in machinists' supplies, as to that in the larger machine tools. The factories which have recently been supplied with the latter and gone to work appear to be in the market for the former. A seller of tool supplies such as files and drills, states that his trade of the past two or three months has been almost altogether with bicycle manufactories. Prices generally are undergoing little change, but those of certain articles dependent upon the iron market have a weakening tendency. The larger lines of goods, which would perhaps be classed as mill supplies, are in about the same position in regard to demand as the smaller.

We shall now consider some classes of machinists' supplies and give a few reports from out-of-town companies which

have kindly responded to questions addressed to them, and which, though perhaps representing especially those concerns which are busy, show that in some quarters considerable work is being done.

In emery and emery wheels, the tone of the market is fairly good, though in the latter trade is certainly not up to that of January. Prices are likely to remain about the same through the year. The Sterling Emery Wheel Co., Tiffin, O., write that orders for emery and corundum wheels have been coming in freely and that they expect a large business this year. Not only are there orders from a varied patronage, but regular customers are ordering larger quantities. A seller of emery wheels in this city, however, reports less orders than formerly from regular customers, but an increase from new manufacturers. Another corroborates, in respect to polishing and grinding supplies, the dulness of the present month in machinists' supplies generally and says that business has been less than in February, 1895, but that for the last ten days out-of-town trade has been looking up.

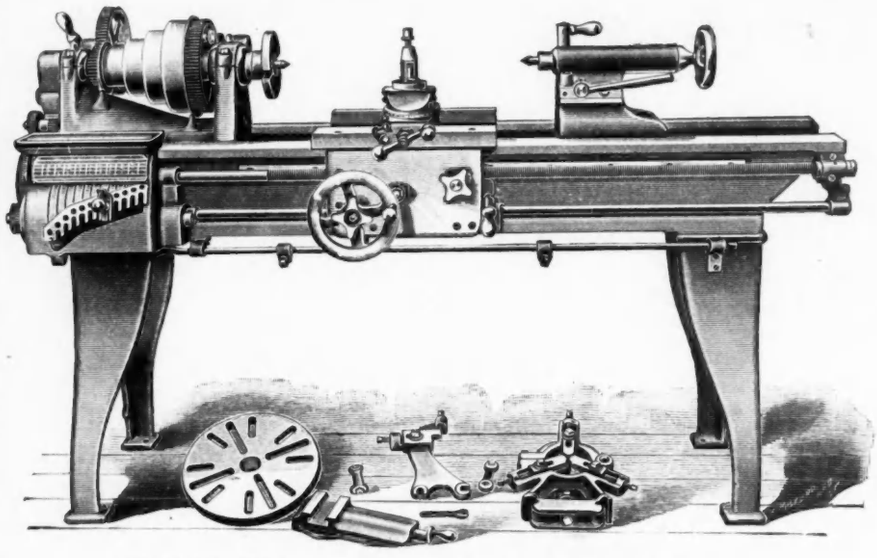
In twist drills the tone is a strong one. While they may in some quarters be subject to a present retardation in common with other tools, yet some of the concerns making a specialty of them talk very encouragingly. The Morse Twist Drill & Machine Co., New Bedford, Mass., advise us from the factory that they are fully occupied, running full hours with a full complement of help, and the New York agency of another company has had a better business this month than last, which is more than was expected. Prices are holding their own.

Regarding nuts and bolts, although some people who stand near the consumers consider that trade has been pretty good, at least in January, and some manufacturers are said to hold favorable views, yet certain of the authorities upon the subject are not elated. It is said, however, that considerable demand is now coming from car shops. Prices have a weakening tendency.

The Worcester Machine Screw Co., Worcester, Mass., are busy in all departments and have been so for the past eight months. No change has been made in prices since October 1st last, when there was a slight advance made on set and cap screws. They think the business outlook is better than it was two months ago, and, as far at least as they are concerned, encouraging for 1896.

Speidel & Roeper, Reading, Pa., report that demand for hoists, traveling cranes and overhead tramways is very irregular from month to month and prices also are indefinite. They have found January a fair month in both respects and February promises to be on a level with the average months for the past year.

In leather belting prices have for some time been generally unchanged, and there is a tendency to maintain them. The



14 in. x 6 ft. Hendey-Norton Lathe with Improved Automatic Stop.

THIS Lathe COMBINES the LATEST and BEST Improvements. Automatic Stop. It is Simple, Durable, Indispensable. It will AUTOMATICALLY STOP the Carriage in EITHER direction. It is equally efficient whether FEEDING or THREAD-CUTTING. Running up to a shoulder, boring to BOTTOM of holes, or INTERNAL THREAD-CUTTING.

No danger of spoiling either tool or work. It is a safeguard against accidents, in either direction.

Feeds — It has all feeds in daily use with simple movement of lever.

Threads — It has all threads in daily use with simple movement of lever.

Carriage — The carriage reverses in Apron. No slamming of Countershaft. There is no comparison between this Lathe and the old style or common Lathe. Quick work, rapid changes, satisfactory results. BUY THE BEST.

SEND FOR CIRCULAR.

The Hendey Machine Co.

TORRINGTON, CONN.

European Agents:

CHAS. CHURCHILL & CO. (Ltd.),
21 Cross Street, Finsbury, London.

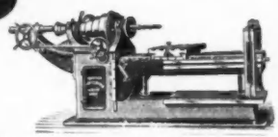
SCHUCHARDT & SCHUTTE,
59 Spandauerstrasse, Berlin.

SOLLER, Basel, Switzerland.

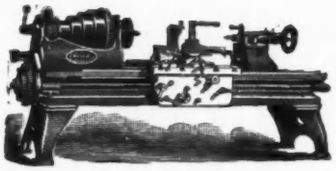
PRATT & WHITNEY CO.,
Hartford, Conn., U. S. A.,
MAKERS OF
FINE MACHINE TOOLS.
Complete Plants Furnished for BICYCLE, TYPE-WRITER, GUN and SEWING MACHINE MAKERS.
GAUGES AND SMALL TOOLS FOR GENERAL MACHINE WORK.
DROP HAMMERS and TRIMMING PRESSES.
FORGING AND TRIMMING DIES FOR ALL CLASSES OF WORK.
England—BUCK & HICKMAN, 280 Whitechapel Road, London, E.
England—CHAS. CHURCHILL & CO., Ltd. 21 Cross St., Finsbury, London, E.C.
France—FENWICK FRERES & CO., 21 Rue Martel, Paris.
France—F. G. KREUTZBERGER, 140 Rue de Neuilly Futeaux (Seine).
CHICAGO—42 and 44 South Clinton, cor. Washington Street.
BOSTON—47 Pearl Street.
NEW YORK—138 Liberty Street.

Roughing Reamer.

Finishing Reamer.
FINE REAMERS
SPIRAL FLUTES.
Also Screw Plates, Taps, Dies and Machinery.
Send for Catalogue.
Wiley & Russell Mfg. Co.,
GREENFIELD, MASS.

DRILLS Immediate Delivery.
Special Machines to Order.
CATALOG E.
FITCHBURG MACHINE WORKS, FITCHBURG, MASS.

Hor. Boring and Drilling Machine.

3 CATECHISMS FOR PRACTICAL MEN.
STEAM ENGINE CATECHISM, - $2.00
ENGINE RUNNERS' CATECHISM, 2.00
PRACTICAL CATECHISM, - - 1.25
ALL BY ROBERT GRIMSHAW.
AND BOUND IN RED CLOTH. JOHN WILEY & SONS, NEW YORK.


NEW HAVEN MANFG. CO.
NEW HAVEN, CONN.
IRON-WORKING MACHINERY,
Planers, Shapers, Drills, Slotters, Etc.

CURTIS & CURTIS,
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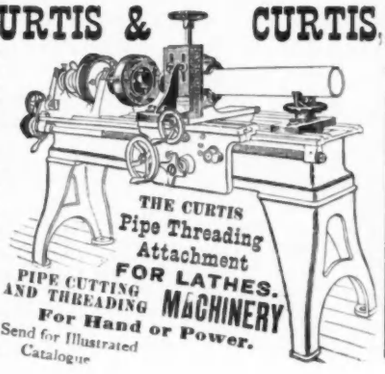
THE CURTIS Pipe Threading Attachment FOR LATHES.
PIPE CUTTING AND THREADING MACHINERY
For Hand or Power.
Send for Illustrated Catalogue

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I would like to be the Patent Attorney who comes first to your mind.
L. SEWARD BACON,
Correspondence Promptly Answered.
614 F Street, N. W., Washington, D. C.

BOILER MAKERS.
The best books for laying out boiler work are Nicholl's Theoretical and Practical Boiler Maker and Engineers' Reference Book, price $2.50; and Courtney's Boilermaker's Assistant in Drawing, Templating and Calculating Boiler Work and Tank Work, price 80 cents. Sent on receipt of the price by the Philadelphia Book Co., 19 S. Ninth Street, Philadelphia, Pa.
Catalogue free.

present month is considered dull as compared with last, notwithstanding certain houses are fairly well employed. There have been a number of failures in this line which, though in some respects it is beneficial to those who keep afloat, reflects unfavorably the state of trade. One complaint is that so much business has to be done on credit.

Iron and Other Metals.

The pig iron market remains in the rather quiet condition which has characterized it for some time past. The average volume of trade during this week is said, however, to be as large as that of last. There is at present a tendency on the part of furnaces to go out of blast and this is likely to continue while present prices prevail. In Pittsburg Bessemer pig has been inactive this week.

Copper holds pretty firm prices, with free export selling but with home consumers well covered.

Tin is flat, and with little doing.

Lead maintains a firm tone, with favorable cables but conservative domestic buying.

Spelter is quiet and featureless.

QUOTATIONS.

NEW YORK, Monday, February 24th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$12 75 @ $13 50
No. 2 foundry, Northern	12 00 @ 12 50
No. 2 plain, Northern	11 25 @ 11 75
Gray Forge	11 00 @ 11 50
No. 1 foundry, Southern	12 50 @ 12 75
No. 2 foundry, Southern	12 00 @ 12 25
No. 3 foundry, Southern	11 50 @ 12 00
No. 1 soft, Southern	12 00 @ 12 50
No. 2 soft, Southern	11 75 @ 12 25
Foundry forge, Southern	11 00 @ 11 50

Bar Iron—Base, in Carloads—Mill price, on dock: common, 1.20 @ 1.30c.; refined, 1.30 @ 1.50c. Store prices: common, 1.50 @ 1.60c.; refined, 1.60 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5¾ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—About 1.55c. in carloads, mill price; from store, 1.85c. Special brands upward.

Cold Rolled Steel Shafting—Base, 2½c. in carloads; 2¾c. in smaller quantities; 3c. from store.

Copper—Carload lots, Lake Superior ingot, 11c.; electrolytic, 10¾ @ 10¾c.; casting copper, 10½c.

Pig Tin—For wholesale lots, 13.50 @ 13.55c. Metal Exchange quotation, 13.35 @ 13.45c.

Pig Lead—In carloads, 3.20 @ 3.25c.

Spelter—Some brokers quote 4.00 @ 4.05c., New York delivery, but 4.15 @ 4.20c. is also given. Probably the former is the nearer correct. The Metal Exchange quotes 4.00c. in lots of not less than 30,000 pounds.

Antimony—From store, in cask or wholesale lots, Cookson's, 7¾ @ 7⅞c.; Hallett's, 6⅞ @ 7c.; Japanese, 6¾ @ 6⅞c.

Lard Oil—Prime city, present make, 51 @ 53c. in large quantities.

MANUFACTURES.

At the Altoona and Juniata shops thirty-eight new locomotives are to be made for the Pennsylvania railroad.

The Comstock Motor Co., of Topeka, Kan., was recently organized with a capital of $100,000. The directors are G. J. Mulvane and D. W. Mulvane.

The Electrical Equipment Co., of Portland, Me., is a new concern for the purpose of manufacturing all electrical appliances. H. M. Davis of Portland is president.

The Berlin Iron Bridge Co., of East Berlin, Conn., have contract for a steel floor to be placed in one of the buildings of the Alexander Smith & Sons Carpet Factory, at Yonkers, N. Y.

The Turney Illuminating Co., Chicago, Ill., has been organized with a capital of $100,000 to manufacture electrical appliances. Incorporators are Nelson C. Gridley, John E. Halfpenny, and others.

The Franklin Steel Casting Co., Franklin, Pa., have added a fifteen-ton furnace to their melting

plant. They have contracted for an addition to their foundry, 300 x 150 feet, also an addition to their pattern shop of 100 x 50 feet.

The Foster Engineering Co., of Newark, N. J., have just received a large order from England for valves ranging in size from ¾ inch to 10 inches; have also shipped twenty-five of their Air-Brake Pump Governors to Vienna, and made a further large shipment of valves to Bremen.

C. M. & J. B. Hart, Clarksburg, West Va., whose machine shop, foundry and pattern shops were destroyed by fire on January 29th, have established a temporary office in the West End, and hope for a speedy resumption of business. Meanwhile they will continue to fill all orders as far as possible.

NEW CATALOGS.

There are three sizes of Standard Catalogs, 9"X12", 6" X 9" and 4½" X 6". We recommend the 6" X 9" size for machinery catalogs. When they must be larger or smaller, one or the other standard sizes should be adopted if possible.

"A Yard of Unsolicited Testimonials" is the title of a neat compilation of letters a yard long from pleased customers of the Peerless Drilling Compound Co., of 850-852 Genesee street, Utica, N. Y., who manufacture a substitute for cutting oil, costing, it is claimed, only one cent per gallon.

Darling, Brown & Sharpe, of Providence, R. I., have issued a small pamphlet giving illustrations of and particulars about their new tempered steel rules. These rules are much the same as the untempered ones, with which most machinists are familiar, but are tempered, and yet of guaranteed accuracy. The company state that the successful manufacture of these rules, at a cost that places them within easy reach, is regarded as one of their greatest triumphs. The list includes thin, flexible, as well as rules of the regular thickness. The pamphlet is 3⅛ x 5½ inches, and is sent to those interested on application.

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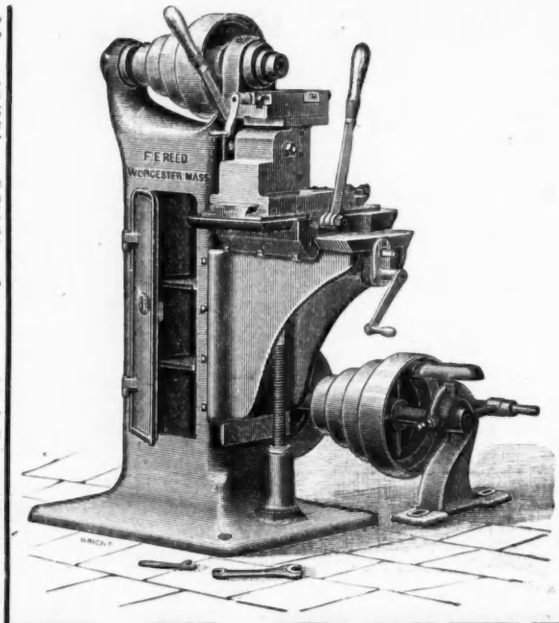

NEW PATTERN HAND MILLING MACHINE.

F. E. REED CO.,
WORCESTER, MASS.

Lathes and Milling Machines.

FOR FURTHER INFORMATION REGARDING THIS NEW MILLING MACHINE, SEND FOR CATALOGUE CONTAINING COMPLETE DESCRIPTION . . . . . .

EVERY MACHINIST SHOULD HAVE A COPY OF

OUR CATALOGUE.

It is a 704 page cloth bound book. A copy will be sent, express paid, to any one sending $1.00, and the money paid for book will be refunded with first order amounting to $10.00 or over.

MONTGOMERY & CO.,
105 FULTON STREET,
NEW YORK CITY.

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

Will work in any position.

Weighs 48 lbs. and drills from ⅛ to 2¼ inches diameter.

Runs with Steam —OR— Compressed Air.

Send for Circular.

Manufactured by J. G. TIMOLAT, 465 & 467 W. Broadway, NEW YORK.

FOR SALE.

The Westinghouse Machine Company is about moving into its new plant, and offers at low prices certain machinery which will be replaced by more modern tools. Parties wishing to buy lathes, planers, boring mills, etc., may see tools in operation at Twenty-fifth and Liberty Streets, Pittsburgh, Pa.

MACHINISTS' SCALES,
PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

ENGINE LATHES. . . . .
HAND LATHES. . . . . .

Draper Machine Tool Co.
Successor to LATHE & MORSE TOOL CO.
WORCESTER, MASS., U. S. A.

. . . . PLANERS.
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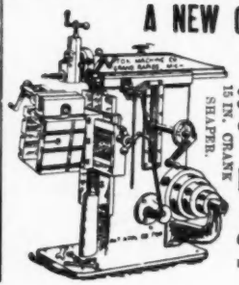

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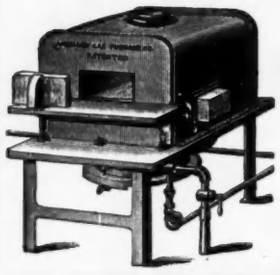

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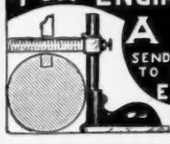

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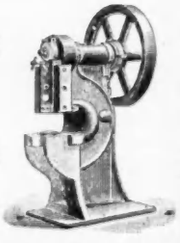

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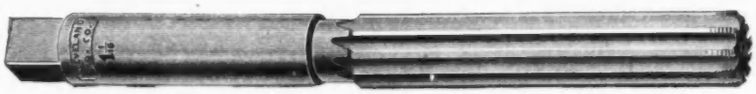

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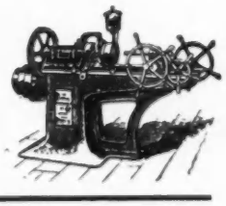

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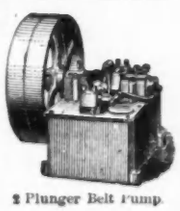
WATSON & STILLMAN, PROPRIETORS.
204, 206, 208 and 210 East 43d Street, New York.

Hydraulic Flange Packings.



2 Plunger Belt Pump.

BUYERS' FINDING LIST—Continued.

Cutting-Off Machines.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Machine Co., So. Sudbury, Mass.

Damper Regulators.
Hine & Robertson Co., New York.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Carpenter, J. M., Pawtucket, R. I.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drawing Instruments, Etc.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffell & Esser Co., New York.

Drilling Compound.
Peerless Drilling Compound Co., The, Utica, N. Y.

Drilling Machines.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Baush & Sons, C. H., Holyoke, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Co., Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., E., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Montgomery & Co., New York.
New Haven Mfg. Co., New Haven, Conn
Newton Machine Tool Works, Philadelphia, Pa.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Quint, A. D., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Stover Novelty Works, Freeport, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drill Gage.
Wyke, J., East Boston, Mass.

Drill Rods.
Abbott, Wheelock & Co., Boston, Mass.

Drills, Twist.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

Drop Forgings.
Billings & Spencer Co., Hartford, Conn.
Wyman & Gordon, Worcester, Mass.

Dynamos.
Roth Bros. & Co., Chicago, Ill.

Elevators.
Albro-Clem Elevator Co., Philadelphia, Pa.

Emery Wheels.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Sterling Emery Wheel Co., Tiffin, O.

Engines, Gas and Gasoline.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Wolverine Motor Works, Grand Rapids, Mich.

Engines, Steam.
Ames Iron Works, Oswego, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Ide & Son, A. L., Springfield, Ill.
Keystone Engine and Machine Works, Philadelphia, Pa.
Orr & Sembower, Inc., Reading, Pa.
Watts-Campbell Co., Newark, N. J.
Weston Engine Co., Painted Post, N. Y.

Exhaust Oil Extractors.
Hine & Robertson Co., New York.

Feed Water Heaters and Purifiers.
Hine & Robertson Co., New York.
National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

Files.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Strelinger & Co., Chas. A., Detroit, Mich.

Flexible Tubing.
Almond, T. R., Brooklyn, N. Y.

Friction Cones.
Evans Friction Cone Co., Boston, Mass.

Furnaces.
American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

Continued on page 32.

BUYERS' FINDING LIST—Continued.

Gages.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Taylor-Rice Engineering Co., Gloucester City, N. J.
Wyke, J., East Boston, Mass.

Gear Cutters.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant, Geo. B., Lexington, Mass.
Hill, Clarke & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Machine Co., D. E., New London, Conn.

Gears.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant, Geo. B., Lexington, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

Graphite.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grinders, Center.
Barker & Co., William, Cincinnati, O.
Leland & Faulconer Mfg Co., Detroit, Mich.
Trump Bros. Machine Co., Wilmington, Del.

Grinding Machines, Universal.
Brown & Sharpe Mfg. Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

Grinding and Polishing Machines.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Leland & Faulconer Mfg. Co., Detroit, Mich.
McCabe, J. J., New York.
Norton Emery Wheel Co., Worcester, Mass.
Place Machine Co., George, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.

Grinding Machine, Cutter.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Garvin Machine Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.

Hack Saws.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Q & C. Co., Chicago, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.

Hammers, Drop.
Long & Allstatter Co., Hamilton, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Stiles & Fladd Press Co., Watertown, N. Y.
Pratt & Whitney Co., Hartford, Conn.

Hoists.
Harrington, Son & Co., E., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Hydraulic Machinery.
W. & S. Hydraulic Machinery Works, N. Y.

Injectors.
Hayden & Derby Mfg Co., New York.
Jenkins Bros., New York.
Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Jack Screws.
Capital Machine Tool Co., Auburn, N. Y.

Keyway Cutter.
Baker Bros., Toledo, O.

Lathes (see also Turret Lathes).
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Brown & Sharpe Mfg Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis, W. P., Rochester, N. Y.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dawson & Goodwin, Chicago, Ill.
Dietz, Schumacher & Co., Cincinnati, O.
Draper Machine Tool Co., Worcester, Mass.
Fifield Tool Co., Lowell, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., E., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Hendey Machine Co., Torrington, Conn.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
New Doty Mfg. Co., Janesville, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark, John, Boston, Mass.

Milling Attachment.
Adams Co., The, Dubuque, Iowa.

Continued on page 33.

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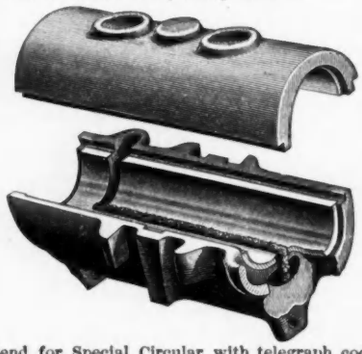

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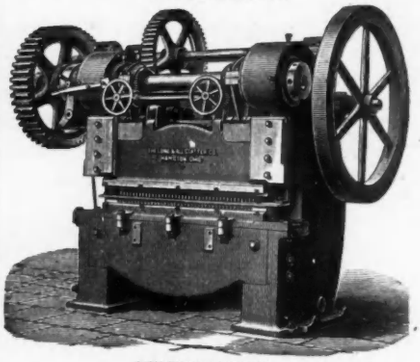

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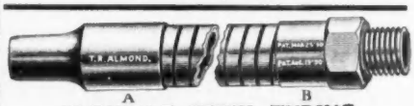

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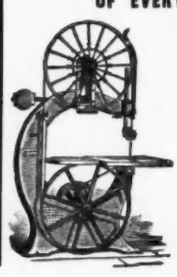

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